

**ENVIRONMENTAL COMPLIANCE
AND POLLUTION PREVENTION GUIDE**
for the
Electronics and Computer Industry

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New York State Department of Environmental Conservation
Pollution Prevention Unit



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INTRODUCTION

This environmental compliance guide is the third in a series of industry-specific manuals that has been developed by the Pollution Prevention Unit to assist businesses in New York State with environmental regulations, better waste management and waste minimization methods. It was developed as a supplement to the *Environmental Compliance and Pollution Prevention Guide for Small Quantity Generators* (SQG) manual, which is intended for any small and medium-size business that generates hazardous waste. If your business generates hazardous waste, the SQG manual will give you a good overview of the hazardous waste regulations along with a summary of the air and water regulations.

Also developed as part of this industry sector outreach is the manual, *Environmental Self-Assessment for Electronics Industry*, which is intended to help your business achieve the maximum performance from your day-to-day operation as well as prevent pollution and identify opportunities for additional pollution prevention measures. For the most part, smaller businesses are trying to comply with applicable regulations and are willing to implement pollution prevention measures if information could be presented to them in a format that is easy to understand. In an effort to assist those businesses that are in the electronics and computer industry sector, DEC is offering this manual to provide information on how to properly manage wastes that are generated at these facilities. This guide is divided into five sections:

Section I - An overview of the electronics/computer industry.

- # **Section II** - A summary of DEC regulations as they pertain to the electronics/computer industry.
- # **Section III** - Identification and management of waste streams that are generated by the electronics/computer industry and pollution prevention tips for each waste stream mentioned.
- # **Section IV** - Pollution prevention options for the electronics/computer industry.
- # **Section V** - A resource guide that will assist the electronics industry with names and addresses of technical assistance providers.

Preventing waste is better than having to manage it. If your company generates less waste, you will have less waste to manage and dispose of, resulting in lower disposal fees. If your business generates less waste, you reduce your risk of spills and discharges that contaminate the environment; you also reduce your liability risk.

When you and your employees familiarize yourselves with both the *Environmental Compliance and Pollution Prevention Guide* and the *Environmental Self-Assessment Guide*, your electronics/computer facility will have a competitive advantage as far as knowing the regulations and the latest pollution prevention techniques. Keep this manual where it will be available to your employees so they can refer to it as needed.

Section I - Description of the Electronics and Computer Industry

INTRODUCTION

This section is designed for those interested in gaining a general understanding of the industry and an overview of the manufacturing process for semiconductors, printed wiring boards, and cathode ray tubes. This section does not attempt to replicate published engineering information that is available for this industry. The product sectors discussed in this section, semiconductors, printed wiring boards (PWBs), and cathode ray tubes (CRTs), pose significant environmental concerns during the manufacturing processes and comprise a large portion of the electronics and computer industry.

The electronics industry is composed of five major sectors: telecommunications, computers, industrial electronics, consumer electronics, and semiconductors.

Even though California has the largest concentration of industry workers in the semiconductor field, Texas, Arizona, Massachusetts, and New York also have high employment in the semiconductor industry. The majority of printed wiring board (PWB) manufacturers are located in Texas, California, Illinois, New York, and Massachusetts.

With approximately 1,200 companies in the electronics and computer industry in New York, it is important that this industry sector properly manages the many different waste streams that may be generated from these facilities. Wastes from air emissions, process water, and a variety of solid and hazardous wastes will have to be managed in accordance with applicable DEC regulations. Pollution prevention should play an important role for many companies in the minimization of many

of these harmful wastes. There is a growing need for New York's electronics and computer industry to understand and comply with environmental regulations in order to avoid enforcement actions and/or fines as well as potential harm to human health and the environment.

CHEMICAL PROCESSES

The chemical processes that are involved in the electronics/computer industry include:

- # Degreasing
- # Pickling
- # De-rusting
- # Stripping of metal coatings
- # Passivating
- # Activating
- # Phosphating
- # Chromating
- # Electroless copper plating
- # Electroless nickel plating
- # Bright dipping
- # Hardening

ELECTROLYTIC PROCESSES

The electrolytic processes that are involved in the electronics/computer industry include:

- # Degreasing (e.g., vapor, emulsion, detergent)
- # Pickling
- # Electrocleaning
- # Etching
- # Plating (e.g., copper, nickel, gold, silver)
- # Anodizing (e.g., sulfuric, chromic)
- # Electropolishing

The following is a brief description of how semiconductors, printed wiring boards, and cathode ray tubes are manufactured.

Semiconductors

Some of the largest U.S. producers of semiconductors are: Motorola, Intel, Texas Instruments, National Semiconductor, and Advanced Micro Devices.

Semiconductors are made of a solid crystalline material, usually silicone, formed into a simple diode or many integrated circuits. A simple diode is an individual circuit that performs a single function affecting the flow of electrical current. Integrated circuits combine two or more diodes. Integrated circuits are formed on wafers. Usually a wafer contains between 200 to 300 circuits, but they can contain up to several thousand. The area on the wafer occupied by integrated circuits is called a chip or die.

The primary reason that semiconductors fail is due to contamination which is usually due to any microscopic residue, chemicals, or dust on the surface of the base material or circuit path. Therefore, a clean environment is essential to the manufacture of the semiconductors. Cleaning operations usually occur before and after each manufacturing process step: crystal processing, wafer fabrication, final layering and cleaning, and assembly.

CRYSTAL PROCESSING

Because crystals of pure silicon are poor electrical conductors, controlled amounts of **dopants** (chemical impurities) are added during the development of silicon ingots to enhance their semiconducting properties.

Dopants are typically applied using diffusion or ion implantation processes and eventually form the circuits that carry the flow of current.

Diffusion is a chemical process which exposes the regions of the silicon surface to vapors of the metal additive (dopant) while maintaining high temperatures. The process is complete when the additives migrate to the proper depth and reach the appropriate concentration in the silicon wafer.

Ion implantation is a process that allows for greater control of the location and concentration of dopants added to the wafer. Metal dopants are ionized and accelerated to a high speed where the ions will penetrate the silicon surface and leave a distribution of the dopant.

Either doping process can be used in semiconductor manufacturing. Antimony, arsenic, phosphorus, and boron compounds are the dopant materials most commonly used for silicon-based semiconductors. Other dopants include aluminum, gallium, gold, beryllium, germanium, magnesium, silicon, tin, and tellurium. Wastes including antimony, arsenic, phosphorus, and boron may be generated in the wastewater as a result of ion implantation or diffusion. Also, excess gases may be generated.

The crystal ingots are sliced into round wafers approximately 0.76 mm (0.03 inches) thick and then rinsed. The wafer's surface may be mechanically ground, smoothed, and polished, as well as chemically etched so that the surface is smooth and free of oxides and contaminants. Chemical etching removes organic contaminants using cleaning solvents and removes damaged surfaces using acid solutions. Chemical etching is usually followed by a deionized water rinse and drying with compressed air or nitrogen. In some cases, silicon wafers are cleaned using ultrasonic techniques, which involve potassium chromate

or other mild alkaline solutions. See section III under parts cleaning and degreasing for more information on ultrasonic cleaning.

Etching is a method of cutting into, or imprinting on the surface of a material. Several etching processes can be used on semiconductors, as well as integrated circuits and printed wiring boards. **Wet etching** uses acid solutions to cut patterns into the metal. **Dry etching** involves reactive gases and uses various halogenated or nonhalogenated gaseous compounds.

Materials used during the wet etching process may include acids (sulfuric, phosphoric, hydrogen peroxide, nitric, hydrofluoric, and hydrochloric), ethylene glycol, hydroxide solutions, and solutions of ammonium, ferric, or potassium compounds. Materials used during the dry etching process may include chlorine, hydrogen bromide, carbon tetrafluoride, sulfur hexafluoride, trifluoromethane, fluorine, fluorocarbons, carbon tetrachloride, boron trichloride, hydrogen, oxygen, helium, and argon. Typical solvents and cleaning agents include acetone, deionized water, xylene, glycol ethers, and isopropyl alcohol. The most commonly used cleaning solution in semiconductor manufacturing includes a combination of hydrogen peroxide and sulfuric acid.

WAFER FABRICATION

The next step in the manufacturing of the semiconductor is the wafer fabrication. Wafers are usually fabricated in batches of 25 to 40 and begins with an oxidation step. Oxidation is a process in which a film of silicon dioxide is formed on the exterior surface of the silicon wafer. Thermal oxidation takes place in a tube furnace with controlled, high temperatures and a controlled atmosphere. Oxidation is a reaction between the silicon wafer surface and an oxidant gas such as oxygen or steam. This

process may be needed as a preliminary step before diffusion or ion implantation (doping) in order to protect the wafer during further processing. Following oxidation, the wafer surface is thoroughly cleaned and dried. Materials used during oxidation, include silicon dioxide, acids (hydrofluoric), and solvents. Materials such as oxygen, hydrogen chloride, nitrogen, trichloroethane, and trichloroethylene may also be used. Wastes that may be generated from this process include: organic solvent vapors from cleaning gases, rinse waters with organic solvents from cleaning operations, spent solvents, and spent acids and solvents in the wastewater.

Next, patterns are imprinted onto the substrate using photolithography (also referred to as lithography) and etching processes. The steps in the photolithography process are:

- # The precise alignment of mask to wafer and exposure to UV light. Negative resist is polymerized.
- # The removal of unpolymerized resist.
- # The selective removal of top surface layer.
- # The cleaning of **photoresist** (a light sensitive chemical) from the wafer's surface.
- # Inspection of wafer for correctness of image transfer from photoresist to top layer.

Photolithography is the most crucial step in semiconductor manufacturing because it sets a device's dimensions. Incorrect patterns affect the electrical functions of the semiconductor.

Photolithography is a process similar to photo processing techniques and other etching processes in that a pattern is imprinted. The silicon wafer is coated uniformly with a thin film of resist and then a glass plate or mask is

created with the circuit pattern. One way that the circuit pattern is imprinted, a process called optical photolithography, is by the projection of x rays through a special mask close to the silicon slice. Another type of optical photolithography is by electron-beam direct patterning, which uses a controllable electron beam and an electron sensitive resist. This process does not need a mask. Once the pattern is developed, some areas of the wafer are clear and the rest are covered with resist.

Next, chemical developers are used to remove unnecessary coatings or resist material that remains on the substrate. Development can be conducted by liquid methods (dip, manual immersion, or spray coating) or dry methods (plasma). The wafer is then etched in an acid solution to remove selected portions of the oxide layer to create depressions or patterns. The patterns are areas in which dopants will be applied. The wafer is rinsed, typically by immersing in a stripping solution to remove unwanted photoresist, and then dried.

During the next step, dopants are applied to the patterned wafer surface typically using diffusion or ion implantation. Additional layers of silicon may also be applied to the wafer using deposition techniques, typically epitaxial growth or chemical vapor deposition. **Epitaxyl** allows the growth of another layer of silicon on top of the wafer. A silicon layer is grown using high temperatures and dopant compounds. This top layer of silicon is where the final device will be formed. Not all semiconductors need this layer. **Chemical vapor decomposition** deposits a thin coating on materials by a chemical process. Vapor deposition is a low pressure process that combines appropriate gases in a reactant chamber at elevated temperatures to produce a uniform film thickness.

Materials that may be used during

deposition include silane, silicon tetrachloride, ammonia, nitrous oxide, tungsten hexafluoride, arsine, phosphine, diborane, nitrogen, and hydrogen.

Wastes that may be generated from these processes include: acid fumes from etching operations; organic solvent vapors from cleaning resist drying, developing, and resist stripping; hydrogen chloride vapors from etching; rinse waters containing acids and organic solvents from cleaning, developing, etching, and resist stripping processes; rinse waters from aqueous developing systems; spent etchant solutions; spent solvents, and spent acid baths.

FINAL LAYERING AND CLEANING

Once the wafer is patterned, the wafer surface is coated with thin layers of metal by a process called **metallization**. These metal layers perform circuit functions within the finished semiconductor. External connections to the silicon wafer are provided by evaporation of thin metal films onto areas of the semiconductor chip surface in a vacuum. Almost every metal can be used to make this electrical connection to the silicon. The most common metals are: aluminum, platinum, titanium, nickel/chromium, silver, copper, tungsten, gold, germanium, and tantalum.

Sputtering and high vacuum evaporation are two types of metallization. **Sputtering** (also called partial vacuum evaporation) is a physical, rather than a chemical process. This process occurs in vacuum chamber which contains a target (solid slab of the film material) and the wafers. Argon gas is introduced in the chamber and ionized to a positive charge and then the solid slab of film material is deposited onto the wafer surface. A uniform thickness of the coating is produced over the silicon slice.

High vacuum evaporation is a metallization process that uses an electron beam, a ceramic bar heated by thermal resistance, or a wire heated by electrical resistance. This method coats the surface of the wafer with metal.

Photolithography and etching are also used to remove any unnecessary metal using chlorinated solvents or acid solutions. Wastes generated include: acid fumes and organic solvent vapors from cleaning, etching, resist drying, developing, and resist stripping; liquid organic waste; aqueous metals; and waste waters contaminated with spent cleaning solutions.

A process called **passivation** is used to apply a final layer of silicon dioxide or silicon nitride over the wafer surface, which provides a protective seal over the circuit. This coating protects the semiconductor from exterior influences and also insulates the chip from unwanted contact with other external metal contacts.

After all layers have been applied to the wafer, the wafer is typically rinsed in deionized water. The back of the wafer is then mechanically ground (also called lapping or backgrinding) to remove unnecessary material. A film of gold may be applied to the back of the wafer by an evaporation process to aid the connection of leads to the bonding pads during a later process step.

A test is performed on each chip to ensure that it meets the design specifications. Chips that do not meet specifications are marked with an ink droplet for discard during assembly operations. The wafer is cleaned again after testing, using solvents such as deionized water, isopropyl alcohol, acetone, and methanol.

Wastes generated from these processes include: spent solvents and acids in the wastewater and rinse water from cleaning,

developing, etching, resist stripping, and rinsing processes; acid fumes and organic solvent vapors from cleaning, rinsing, resist drying, developing, and resist stripping; spent silicon dioxide or nitride; hydrogen chloride vapors from etching; rinse waters from aqueous developing systems; spent etchant solutions; spent acid baths; and spent solvents.

ASSEMBLY

The final step in semiconductor manufacturing is assembly. Semiconductors are assembled by mounting the chips onto a metal frame, connecting the chips to metal strips, or leads, and enclosing the device to protect against mechanical shock and the external environment. Even though there are many types of packaging, plastic comprises a good portion of the market.

Printed Wiring Boards

Printed wiring boards (PWBs), also known as printed circuit boards, are used in many electronic products such as electronic toys, radios, television equipment, computers, medical devices, digital imaging, and industrial control equipment. PWBs are subdivided into single-sided, double-sided, multilayer, and flexible boards. Multilayer boards are manufactured similarly to single and double-sided boards, except that conducting circuits are etched on both the external and internal layers. Multilayer boards allow for increased complexity and density. PWBs are produced using three methods: additive, subtractive, or semi-additive technology.

The subtractive process accounts for approximately 80 percent of PWB manufacturing. The conventional subtractive manufacturing process begins with a board, consisting of epoxy resin and fiberglass, onto which patterns are imaged. In most operations, conducting material, usually copper, is bonded onto the substrate surface to form copper-clad laminate. After drilling holes through the laminate and making those holes conductive, unwanted copper is etched off, leaving copper patterns. The patterns on the board form the



Figure 1 IBM implemented a new printed wiring board manufacturing process at its Endicott, NY site called the “Thin Panel Plater” which is an improvement over the traditional PWB manufacturing process in terms of chemicals and energy consumed and waste products produced. The Thin Panel Plater processes panels horizontally instead of dripping them vertically. Product loading and unloading is automated. There are no intermediate operations for removal, handling or transfer. The panels have been completely cleaned, prepped, plated, and dried by the time they exit the system. The process is fully enclosed, minimizing chemical exposure to employees and exhaust requirements associated with the process. (IBM Photo)

electric circuits that conduct electricity. Multilayer boards typically use metals such as platinum, palladium, and copper to form electric circuits. Specialized PWBs may use nickel, silver, or gold.

Additive technology is used less because it is a more difficult and costly production process. This capital-intensive technology is used primarily for small interconnection components used in multi-chip devices. The production process begins with a base plate upon which a dielectric material is deposited. An interconnecting layer of copper is plated onto the dielectric layer which connects the layers of dielectric material and copper. Copper posts are plated-up and another layer of dielectric material is deposited exposing the posts. The next interconnect layer is plated and makes contact with the posts. Layers of dielectric material, copper, and copper posts are added to complete the interconnect. A lithographic process, similar to the one used in semiconductor manufacturing, diminishes the spaces and widths of the PWB.

There are five principal operations common to the production of PWBs. These include:

- # cleaning and surface preparation
- # catalyst application and electroless plating
- # pattern printing and masking
- # electroplating
- # etching

BOARD PREPARATION

Two-side etched copper dielectric boards (consisting usually of fiberglass and epoxy resin) are separated by an insulating layer and laminated or bonded together, usually by heat and pressure. Photographic tools are used to transfer the circuit pattern to the PWB, and computer control programs are used to control

the drilling, routing, and testing equipment. Preparing the copper-clad board involves drilling holes to establish an electrical path between the layers and to mount components. The boards are then mechanically cleaned to remove drilling wastes (i.e., fine particulate contaminants such as copper). This is achieved by vapor degreasing, abrasive cleaning, chemical cleaning with alkaline solutions, acid dips, and water rinses.

Wastes generated during the board preparation include: airborne particulates, acid fumes, and organic vapors from cleaning, surface preparation, and drilling; spent acid and alkaline solutions; spent developing solutions, spent etchants, and waste rinse waters in the wastewater; and scrap board materials and sludges from wastewater treatment. Drilling and routing dust (copper, aluminum, and gold) are collected and recycled.

ELECTROLESS PLATING

Industries use this process to plate on non-conductors such as plastic or printed circuit boards. However, electroless plating is a more complicated process than electroplating because:

- # it requires a much tighter control over the process parameters;
- # chemical reactions in the electroless process bath causes everything that comes into contact (including the tank) with the process solution is coated with the plating material. Therefore, stripping is required more often (sometimes every few days) and the stripping process can cause significant air releases;
- # the frequency of changing the electroless baths is greater than that of electroplating;
- # the concentrations of organics in the

electroless process chemistries can create greater wastewater treatment problems;

- # electroless solutions are susceptible to impurities which affect the process solution. These impurities can cause reduced ductility and corrosion resistance, pitting, adhesion, and roughness problems.

Electroless plating coats a uniform conducting layer of copper or other material on the entire surface including the barrels of the holes of the prepared board without outside power sources. Instead the bath solution supplies the electrons for the disposition onto the substrate. These baths use a variety of **chelating** and/or **complexing agents** which hold the metals in solution. Some common chelating agents include: ethylenediaminetetraacetic acid (EDTA), citrates, oxalates, cyanides, and 1, 2 diaminocyclohexanetetraacetic acid (DCTA). The most common metals plated in the process are nickel, copper, cobalt, and gold.

After the board is prepared, the next step is to prepare the surfaces of the drilled holes. The holes are prepared by an etchback process to remove smeared epoxy resin and other contaminants by using:

- # sulfuric or hydrochloric acid;
- # potassium permanganate; or
- # carbon tetrafluoride, oxygen and nitrogen.

Electroless plating is used to coat the holes with a material such as copper or graphite carbon.

Even though this coating of copper is not thick enough to carry an electrical current, it does provide a base upon which additional copper can be deposited electrolytically. After

the electroless plating, the boards are dried to prevent the board from oxidation (e.g., rusting).

Waste generated during this process includes: spent electroless copper baths; spent catalyst solutions; spent acid solutions; waste rinse waters; and sludges from wastewater treatment.

IMAGING

During imaging, circuit patterns are transferred onto the boards through photolithography or a stencil printing process. **Photoresist** (i.e., a light sensitive chemical) is applied to the board in areas where the circuit pattern will not be set. The board is exposed to a radiation source and developed to remove the unwanted areas of the resist layer. **Stencil printing** uses a printing process, such as silk screening, to apply a protective film that forms the circuit pattern. Next, the boards are subjected to a light etching process, typically using ammoniacal etchants, to remove rust inhibitor or other metals such as copper. Following the stencil printing process, the protective film is dried, and the exposed copper is etched away with common etchants such as sulfuric acid or hydrogen peroxide. After plating or etching, the photoresist is removed with a photoresist stripper.

Wastes generated during the cleaning and etching processes include: F001, F002, F003, F004, and F005 depending on the concentration of the spent solvents and the mixture of spent halogenated and non-halogenated solvents; spent resist material; and wastewater containing metals (copper). F001-F005 are hazardous waste codes that are assigned to specific wastes. All waste codes can be found in 6 NYCRR Part 371, Hazardous Waste Regulations.

Other wastes generated include organic vapors and acid fumes, spent developing

solutions, spent resist material, spent etchant, spent acid solutions, and sludges from waste water treatment.

ELECTROPLATING

Electroplating is a process in which a metal is deposited on a substrate through electrochemical reactions. Electroplating is required to build up the thickness and strength of the conducting layers to provide reliable electrical conductivity between inner layers or from one side of the PWB to the other. Electroplating can also protect against corrosion, wear, or erosion. This process involves immersing the article to be coated/plated into a bath containing acids, bases, or salts. The industry standard for this process is copper, although many are switching to direct metallization techniques.

The electroplating process for PWBs usually begins by coating the copper laminate with a plating resist (photolithography) which leaves the area exposed to form the circuit pattern. The resist prevents the conductive material from adhering to other areas of the board and forms the circuit pattern. The PWB plating process typically uses copper and tin-lead as plating materials, although silver, nickel, or gold can be used. Copper in a plating bath solution is deposited to a sufficient thickness, and a solvent or aqueous solution is applied to remove the plating resist. The copper coating forms interconnections between the layers and provides electrical contact for electronic parts mounted or assembled on the PWB surface. PWB manufacturers then typically electroplate a tin or tin-lead solder on the board to protect the circuit pattern during the etching or stripping processes. An acid etch solution (ammoniacal,

peroxide solutions, sodium persulfate, cupric chloride, or ferric chloride) removes the exposed copper foil, leaving the thicker copper plating to form the circuit pattern. Ammoniacal and cupric chloride are the primary etchants used by PWB manufacturers. Fluoroboric acid is used in the tin-lead plating process to keep the metals dissolved in the solution and to ensure a consistent deposition of the tin-lead alloy onto the circuit board. After the plating bath, the board is rinsed with water, scrubbed, and then dried to remove the copper, spray etch solutions, and other materials. Rinsing ends the chemical reactions during plating and prevents contamination or dragout from being released in the next bath or rinse water. **Dragout** is the plating solution that sticks to parts after they are taken out of the plating bath. Dragout can occur in any bath step, not just in one plating bath. The tin-lead layer is generally removed and the panel is electrically tested for shorts and discontinuities in the electrical pathway.

The primary hazardous wastes generated during plating include: photoresist skins, F006 sludge from plating wastewater treatment, D008, F007, and F008 from plating and etching; spent acid solutions, waste rinse waters, spent developing solutions, spent etchant, and spent plating baths in the wastewater; organic vapors from spent developing solution and spent resist removal solution; and acid and ammonia fumes.

SOLDER COATING

Solder coating is used to add solder to the PWB copper component before assembly. Fabricators use several methods of solder coating, but all of them involve dipping the panel into molten solder. The solder, an alloy consisting of 60 percent tin and 40 percent lead, coats the pads and holes not covered by solder mask. All the excess solder is removed

(a process called leveling) with a blast of hot oil or hot air except for the solder that has formed a chemical (intermetallic) bond with the copper.

ELECTRICAL AND MECHANICAL TESTING

A cross section is cut from a sample panel from each lot using a grinding process called routing, and the plated holes are examined with a photomicrograph. Individual circuit boards are cut out of panels that pass quality control. Routing generates dust which may contain copper, lead, or other metals plated to the panel, but the dust is recycled. Electrical tests, dimensional and visual inspections, and quality audits are performed to ensure compliance with customer requirements. Finally, the finished PWBs are packaged, labeled, and shipped to the customer.



Figure 2 *An example of how fumes are captured and removed during a hand-held soldering operation.*

ASSEMBLY AND SOLDERING

After the PWBs are manufactured, the electrical components are attached during assembly. Adhesives are applied to the boards, and then the components are attached and

soldered to the boards. Components are attached to the PWB by a process called **soldering**. There are several different kinds of soldering processes, including wave, dip, and drag. In wave soldering, the PWB is passed over the crest of a wave of molten solder, thereby permanently attaching the components to the board. A type of chemical known as **flux** is used before soldering to facilitate the production of the solder connection. Not only does flux clean the surface and remove oxidized material, it prevents oxidation from occurring during the solder process. After the solder has been applied, the flux residue may be removed from the board with deionized water instead of CFCs (such as Freon 113) and trichloroethane (TCE). When the soldering is completed, the board may be cleaned and dried.

Some assemblies are using a process called **“no-clean soldering”** which uses no flux during the soldering operation. Lockheed Martin in Syracuse, New York uses the no-clean soldering process and has noticed a significant cost savings and environmental benefits from this changeover.

The wastes generated during assembly include: solder dross, post-solder scrap boards, filters, gloves, rags, and spent gaseous or semi-gaseous solvents from cleaning processes. The wastes that may be generated during soldering, flux application, and cleaning include: organic vapors; copper, lead, spent solvents, and spent deionized water into the wastewater; solder dross; and wastewater treatment sludge. Solder dross, which can be recycled off site, is primarily oxidized solder skin that forms on any molten solder exposed to oxygen.

Cathode Ray Tubes

Cathode Ray Tubes (CRTs) have four major components: the glass panel (faceplate), shadow mask (aperture), electron gun (mount), and glass funnel. The glass funnel protects the electron gun and forms the back end of the CRT. In response to electrical signals, the electron gun emits electrons that excite the screen. The shadow mask forms a pattern on the screen. The shadow mask itself is a steel panel with a mask pattern applied through one of several kinds of photolithography. The process is grouped into six steps: preparation of the glass panel and shadow mask, application of the coating to the glass panel interior, installation of the electron shield, preparation of the funnel and joining to the glass panel/shadow mask assembly, installation of the electron gun, and finishing.

PREPARATION OF THE PANEL AND SHADOW MASK

The shadow mask is constructed from a thin layer of aluminum steel (referred to as a flat mask) which is etched with many small slits or holes, and a metal frame that supports the flat mask. The shadow mask serves as a template for preparing a pattern on the glass panel surface. Shadow masks are commonly manufactured overseas and shipped to CRT manufacturers in the United States. The shadow mask is then molded to match the contour of the glass panel's interior surface and "blackened" in an oven to provide corrosion resistance. Finally, the shadow mask is welded to a blackened metal frame that provides support. Degreasing solvents and caustics are frequently used for cleaning the shadow mask assembly and production equipment. Oils are used for lubricating the press and other

production equipment. The front end glass panel is purchased from a glass manufacturer and shipped to the CRT manufacturer. The shadow mask is carefully positioned inside the glass panel. The glass panel and shadow mask preparation operation frequently uses organic solvents or caustic cleaners for degreasing, oil for equipment maintenance, and oxidizers, such as hydrogen peroxide, for cleaning reclaimed masks.

Wastes generated during this step include spent solvents in the wastewater, vapors from solvent degreasing tanks, and waste glass from breakage.

APPLICATION OF COATING TO PANEL INTERIOR

For the panel-mask to create images, a special coating is applied to the interior surface through a process called screening. Screening, the most complex part of the manufacturing process, is comparable to a photographic development process. First, the mask is removed and the glass panel is washed to remove dust, oil, grease, and other contamination. The glass panel wash commonly uses acids and caustics followed by deionized water rinses for cleaning the glass. The glass panel undergoes the carbon stripe process, which uses organic photoresist, chromate, deionized water, dilute acids and oxidizers, and carbon slurry with binding agents. Surfactants are used to produce the black and clear striped pattern called the "black matrix". The clear areas will eventually be filled with color-producing phosphors. The glass panels are coated with a photoresist, which contains chromate as a catalyzer. The panel is spun to even out the photoresist and then dried. The shadow mask is re-inserted in the glass panel and a series of exposures are made on the panel surface using ultraviolet (UV) light in a photolithography process. The

light passes through the mask openings to imprint the mask pattern on the photoresist. The mask also shadows the areas of the photoresist that will not be exposed. When UV light contacts the photoresist, polymerization occurs, and the exposed areas become less soluble in water than the non-exposed areas. After the exposure, the shadow mask is removed and the glass panel is sprayed with water to remove the non-polymerized material. The imprinted pattern of exposed photoresist remains on the glass panel. The glass panel is then coated and developed again. The resulting image is essentially a "negative image" of the original photoresist exposure pattern. During the phosphor stripe process, three phosphor colors (green, blue, and red) are used to make a color CRT and are applied using the same steps as the carbon stripe process. The phosphor stripe process uses various chemicals, including phosphor slurries containing metals (such as zinc compounds) and organic photoresists, chromate, deionized water, dilute oxidizers, and surfactants. The phosphor materials that are spun off the panels and removed in the developers are recovered and reclaimed either onsite or by a phosphor vendor. The reclaiming process involves the use of acids and caustics, chelating agents, and surfactants.

Two coatings are then added to the glass panel, which now has the black matrix and the three phosphor colors on it: lacquer (a wax-like layer) to smooth and seal the inside surface of the screen, and aluminum to enhance brightness. The panel is then ready to be joined to the back end of the CRT, known as the funnel. In preparation for joining, the panel edges must be cleaned to remove all traces of contaminants. A clean edge is critical to ensuring a good panel-to-seal connection in the finished CRT. The shadow mask and glass panel are reattached. Chemicals used in these

processes include organic solvents and alcohol, caustics, silica-based coatings, aluminum, acids, ammonia, and deionized water. The material removed in the cleaning process is sent to a smelter to recover metals and sulfites.

Wastes generated during this step include: vapors from the lacquer area; wastewater containing deionized water, acids, oxidizers, carbon slurry, surfactants, chromate, phosphor solutions, chelating agents, caustics, organic solvents, alcohol, silica-based coatings, ammonia, zinc, and aluminum; process cooling waters, liquid wastes from precipitation, washing, filtration, and scrubber blowdown; lacquer wastes from spun off and over-sprayed lacquer; and lacquer remaining in lacquer containers.

INSTALLATION OF THE ELECTRON SHIELD

Most CRT manufacturers employ an internal electron shield to prevent stray electrons from reaching outside the screen area. Computer monitor CRTs often use external shielding, which is installed on the outside of the CRTs glass bulb. Before installation, the shields are cleaned with degreasing solvents or caustic cleaners. The internal-type electron shield is made of thin aluminum and is typically welded to the shadow mask assembly before the panel and shadow mask are connected with the funnel. Metal (steel) springs are also welded to the mask frame at this time. The springs provide an electrical connection between the mask and the funnel interior surface.

Wastes generated from these processes include electron shield degrease wastewaters and metals from the welding.

PREPARATION OF THE FUNNEL

The back end of the CRT (funnel) is purchased from a glass vendor and washed prior to use. The funnel is made of high lead content glass and the resulting wash water contains elevated lead levels. After the funnel is washed, the interior surface is coated with a black graphite coating which is a good electrical conductor and a non-reflective coating. The seat edge of the funnel is cleaned to facilitate bonding with the panel, and frit or solder glass is applied in a bead along the entire surface of the seal edge. The frit, approximately 70 percent lead, has the consistency of toothpaste or caulking. The viscosity of the frit is controlled by the addition of organic solvents. The frit serves as an adhesive to join the panel-mask assembly to the funnel. After the frit is applied, the panel-mask assembly is connected to the funnel, and the whole glass package is placed in a positioning clamp to hold the two parts in place. The connected panel-mask and funnel assembly is then exposed to high temperatures in an oven to fuse the frit joint between the panel and funnel at the seal edges. The frit forms a strong bond between the two pieces of glass. During the frit-seal fusion process, the organic chemicals from the screening operation and in the frit are "burned out" of the CRT. The organic materials must "burn" cleanly to minimize any remaining residue. Wastes generated include wastewaters contaminated with spent black graphic, lead, and chemicals associated with the funnel wash, frit application, and seal surface cleaning.

Wastes generated include frit contaminated clothing, instruments and utensil used to prepare the frit, unusable frit glass, and waste glass from breakage.

INSTALLATION OF THE

ELECTRON GUN

Each CRT contains three guns: one dedicated to each of the phosphor colors used in the screen (red, green, and blue). To produce an electron gun, several metal components are assembled and loaded onto spindles to align the various elements. Glass parts are placed into fixture blocks and heated. When the glass reaches the proper temperature, the metal parts are embedded in the glass. The combination of metal parts and glass make up the gun. The guns are cleaned with organic solvents or caustic cleaners before they are mounted in the neck of the CRT funnel. Materials commonly found in the gun assemblies include metals, high lead glass stem (for electrical connection feed-through and exhaust purposes), ribbon connectors, and other manufacturer-specific parts. The gun assembly is then inserted in the neck of the CRT funnel. The gun is aligned and the CRT funnel neck is fused to the gun by rotating the parts in front of open flame burners. An additional component is welded to the gun assembly to allow for removal of gases from the electron gun in subsequent steps.

Wastes generated from this step include waste glass from breakage and wastewaters contaminated with spent organic solvents and caustic cleaners from mount cleaning.

FINISHING

The CRT "bulb" is still open to the atmosphere after the gun mount is sealed in the neck of the funnel. To complete the tube, the gases are removed by applying a vacuum to the bulb. Organic solvents are used to clean and maintain the vacuum pumps. The bulb is "aged" by an electronic treatment applied to the gun or mount. The CRT is then coated with an external carbon black paint, and a metal band is placed around the outside of the panel with adhesives for implosion protection

and safety. The band also provides mounting brackets for installing the CRT. The finished tube is tested in a high voltage testing station, and the CRT tested thoroughly to ensure that it meets all specifications before shipment.

In some cases where the bulb face needs a special application, such as reference lines for an oscilloscope, a separate panel and funnel are used. A photoresist and mask are used to apply the reference lines on the panel. The single phosphor is applied in the same way as for a one-piece bulb, using a settling solution that contains potassium silicate and, usually, an electrolyte.

TUBE SALVAGE

CRTs may or may not be salvaged. Picture tube salvage operations reclaim spent or rejected picture tubes and return them to production. Salvage operation processes include a panel-funnel acid defrit, acid cleaning of panels and funnels (i.e., nitric acid), and cleaning of the shadow mask. These reclaimed components are returned to the process for reuse or are returned to the glass manufacturer for recycling. A product with knocks, scratches, chips, etc., is repaired. New necks are spliced onto funnels. Electron guns are usually discarded. Glass that cannot be used because of serious defects is recycled back to a glass plant directly or is sent off site for cleaning and segregation before going to a glass plant. The use of a new technology called Flat Panel Displays (FPD) is becoming more common because it offers certain environmental advantages over CRTs such as the tenfold reduction in glass used and substantial power savings. However, poorer screen brightness and substantially higher prices, are limiting the widespread incorporation of FPDs into electronics products.

Section II - Regulations

Air Regulations

OVERVIEW

If your facility has boilers, emergency generators, a spray painting booth, some form of printing operation, or a degreasing operation you will probably have to comply with some State and Federal air regulations. The Clean Air Act (CAA) requires the phase-out of the production of chlorofluorocarbons (CFCs) and several other ozone depleting chemicals. It also imposes controls on CFC-containing compounds. This section of the manual will summarize these air regulations as they deal specifically with the electronics/computer industry.

As part of the manufacturing and assembly process in the electronics/computer industry, volatile organic compounds (VOCs) are emitted from certain solvents, inks, adhesives, paint mixing, paint spraying, surface preparation, and equipment clean-up.

Volatile chemicals produce vapors readily at room temperatures and normal atmospheric pressure, and these vapors escape easily from volatile liquid chemicals. All liquid organic chemicals are considered to be VOCs unless they are specifically exempted from the definition by the EPA. Common examples of VOCs include benzene, toluene, and xylene.

Ground-level ozone, a major component of "smog," is formed in the atmosphere by reactions of VOC and oxides of nitrogen (NOx) in the presence of sunlight. High levels of ground-level ozone can endanger public

health and damage crops and forest. As a means to protect the public health and environment, both DEC and EPA regulate VOC emissions.

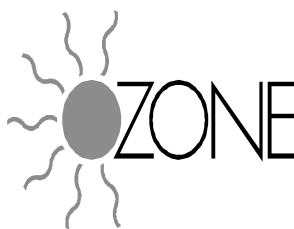
In addition to VOC emissions, the electronics/computer industry may also emit other air emissions such as: acid fumes, particulates, ammonia fumes, chlorinated fluorocarbons (CFCs), organic vapors, and vapors from laquer areas. Many of these air emissions may be Hazardous Air Pollutants (HAPs) which are often subject to additional controls. To obtain a list of HAPs, contact DEC's Division of Air listed in Section V, page 75.

EPA has also established national ambient air quality standards to limit levels of "criteria pollutants". They are: carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide.

The only criteria pollutant that significantly impacts the electronics/computer industry is the standard for ozone. Even though this industry is not a major source of ozone, it is a major source of VOC emissions that mix in the atmosphere to form ozone and smog.

If you suspect that your facility may have any air emissions, you should be familiar with both the state and federal regulations that apply to the electronics/computer industry. Under Title 6 of the New York Codes, Rules and Regulations (6 NYCRR) the electronics/computer industry may have to comply with:

Part 201 (Permits and Registration),



- # Part 212 (General Process Emission Sources),
- # Part 226 (Solvent Metal Cleaning Processes) also known as vapor degreasing,
- # Part 228 (Surface Coating Processes), and
- # Part 234 (Graphic Arts).

The federal regulation applicable to this industry is 40 CFR Part 63.460 (Subpart T), also known as the National Emissions Standard for Hazardous Air Pollutants (NESHAPs) which regulates halogenated solvent cleaning.

The following are some of the most common chemicals that are released in the electronics/computer industry:

Acetone
Ammonia
Carbon Dioxide
Carbon Monoxide

Chlorine
Ethylene Glycol
Glycol Ethers
HAP
Hydrochloric Acid
Hydrogen Chloride
Hydrogen Fluoride
Hydrogen Peroxide
Isopropyl Alcohol
Methanol
Methylene Chloride
Methyl Ethyl Ketone
Nitric Acid
Particulates
Phosphoric Acid
Sulfur Dioxide
Sulfuric Acid
Toluene
Trichloroethylene
VOC
Xylene
Zinc Chloride



Figure 3 *In order to meet air quality standards, this electronics company uses air pollution control equipment for their coating operations.*

DOES YOUR FACILITY NEED AN AIR PERMIT?

Part 201 - Permits and Registration

The information in this section will help you to determine if your facility will require an air permit or registration. The air permit program is regulated under Title 6 New York Codes, Rules, and Regulations, Part 201 (6 NYCRR Part 201).

EXEMPTIONS

Your facility will need to obtain a Minor Facility Registration, State Facility Permit, or a Title V Permit unless every process at the facility is specifically exempt from Part 201. Some common exemptions that may apply to the electronics and computer industry are:

- # Screen printing operations that apply with hand-held squeegees.
- # Printing processes outside the New York Metropolitan Area whose facility-wide VOC emissions do not exceed 20 pounds per day.
- # Graphic label and/or box labeling operations where the inks are applied by stamping or rolling.
- # Surface coating and related operations outside the New York Metropolitan Area and Lower Orange County Area which use less than 25 gallons of coating materials and solvents per month..
- # Your facility performs all abrasive cleaning and surface coating operations in an enclosed building and the emissions are exhausted to emission control devices. These would include a baghouse for abrasive cleaning operations, and a spray booth and dry filters for surface coating operations.
- # Powder coating operations.
- # Thermal packaging operations, including but not limited to, thermimage labeling, blister packing, shrink wrapping, shrink banding, and carton gluing.
- # Presses used exclusively for molding or extruding plastic except where halogenated carbon compounds or hydrocarbons solvents are used as foaming agents.
- # Many degreasing operations are exempt if they don't use HAPs.
- # Venting and exhaust systems for

laboratory operations.

- # Exhaust or venting systems for the melting of gold, silver, platinum, and other precious metals.
- # Exhaust systems for paint mixing, filling or sampling, and/or paint storage rooms or cabinets, provided the paints stored in these locations are stored in closed containers when not in use.
- # Exhaust systems for solvent transfer, filling or sampling, and/or paint storage rooms or cabinets, provided the solvents stored in these locations are stored in closed containers when not in use.
- # Degreasing units which exclusively use non-hazardous air pollutant acids.
- # Degreasing units which exclusively use caustics (e.g., potassium hydroxide and sodium hydroxide).
- # Solvent cleaning of parts and equipment performed exclusively by hand wiping or hand cleaning.
- # Manual surface coating/painting processes which exclusively use brushes,



Figure 4 *Air emissions from this electronics assembly operation are captured and then treated before discharging to the environment.*

rollers, or aerosol cans.

- # Hand-held or manually operated welding, brazing, and soldering equipment.

If you need assistance in determining whether or not your facility is exempt from Part 201 permitting, call the regional DEC air engineer located in your area. (See Section V for phone numbers).

Regulations Information

Air permit requirements can be found in 6 NYCRR Part 201, while the VOC limitations are provided in 6 NYCRR Parts 226, 228, and 234. Facilities should also address the federal requirements of 40 CFR Part 63, Subpart T.

MINOR FACILITY REGISTRATION

The following facilities must operate under a Minor Facility Registration

Facilities in the New York City Metropolitan Area

The New York City Metropolitan Area consists of New York City, and the counties of Westchester, Rockland, Nassau, and Suffolk.

To be eligible to register, a facility located in the New York City Metropolitan Area must meet all of the following conditions*:

- # Total actual annual VOC emissions must be less than 12.5 tons.
- # Total actual annual emissions of any

individual HAP must be less than 5 tons.

- # Total actual annual HAP emissions must be less than 12.5 tons.
- # Total actual emissions of all contaminants must be less than half of all “Major Source” thresholds.

Please note that these “actual annual emissions” limits apply to the rolling 12-month sum of emissions for all periods.

The Major Source thresholds are found in 6NYCRR Part 201-2.1(b)(21).

Facilities Outside of the New York City Metropolitan Area

To be eligible to register, a facility located outside of the New York City Metropolitan Area must meet all of the following conditions*:

- # Total actual annual VOC emissions must be less than 25 tons.
- # Total actual annual emissions of any individual HAP must be less than 5 tons.
- # Total actual annual HAP emissions must be less than 12.5 tons.
- # Total actual emissions of all contaminants must be less than all Major Source thresholds.

Please note that “Annual” emissions are computed on a rolling 12-month basis at the end of each month of operation.

The Major Source thresholds are found in 6NYCRR Part 201-2.1(b)(21).

STATE FACILITY PERMIT

The following facilities must operate under a State Facility Permit*:

Facilities in the New York City Metropolitan Area

- # Total actual annual VOC emissions are greater than 12.5 tons, but less than 25 tons.
- # Total actual annual emissions of any individual HAP are less than 10 tons.
- # Total actual HAP emissions are less than 25 tons.
- # Total actual emissions of all contaminants are less than the “Major Source” threshold.

Please note that “Annual” emissions are computed on a rolling 12-month basis at the end of each month of operation.

The Major Source thresholds are found in 6NYCRR Part 201-2.1(b)(21).

Facilities Outside of the New York City Metropolitan Area

- # Total actual annual VOC emissions are greater than 25 tons, but less than 50 tons.
- # Total actual annual emissions of any individual HAP are less than 10 tons.
- # Total actual HAP emissions are less than 25 tons.

Please note that “Annual” emissions are computed on a rolling 12-month basis at the end of each month of operation.

The Major Source thresholds are found in 6NYCRR Part 201-2.1(b)(21).

TITLE V FACILITY PERMIT

Title V Facility permits are required for all “Major Sources” in New York State. The definition of Major Source is found in 6NYCRR Part 201-2.1(b)(21).

“Non-Major” sources subject to 40 CFR Part 63 Subpart T, regulations for metal degreasing, can obtain a registration and are deferred from Title V permitting until December 9, 1999. These sources must submit a Title V permit by December 9, 2000. However, you should be aware that EPA has proposed to extend the deferral date to December 9, 2004. For more information on 40 CFR Part 63 Subpart T, see section on NESHAP, page 22, or call DEC, Division of Air, or the Small Business Assistance Program listed in Section V.

*The following rules override the conditions listed above for Minor Facility Registrations, State Facility Permits, and Title V Permits:

- # Any new facility that is in an industrial category to which a Federal New Source Performance Standard (NSPS) and which has a potential to emit that is below the major source thresholds must obtain a State Facility Permit, regardless of location or quantity of emissions from that facility.
- # Any new facility that emits a contaminant listed as a hazardous air pollutant, excluding those facilities subject to VOC Reasonably Available Control Technology (RACT) requirements under Parts 226, 228, 229, 230, 233, or 234, must obtain a State Facility Permit, regardless of location or quantity of emissions from that facility.

- # Any facility that is subject to a DEC-approved variance from the requirements of a State VOC RACT regulation must obtain a State Facility Permit, regardless of location or quantity of emissions from that facility.
- # Any facility that is subject to a National Emission Standard for Hazardous Air Pollutant (40 CFR Part 63) must obtain a Title V Permit, regardless of location or quantity of emissions from that facility. However, "Non-Major" facilities that are subject to 40 CFR Part 63 Subpart T (NESHAP for metal degreasing) have been deferred from the requirement to obtain a Title V permit. Such sources are not required to file for a Title V Permit until December 9, 2000.

Owners of these facilities should also be aware that EPA has proposed to extend the deferral date until December 9, 2000. Please call the DEC Division of Air Resources or the Small Business Assistance Program for more details. (See Resource Guide, Section V for phone numbers).

PART 212 - GENERAL PROCESS EMISSION SOURCES

This is the DEC regulation that covers air toxics and determines how much control is needed on your facility's toxic air emissions. Before a permit is written, you must establish your **emission rate potential**. This is the maximum rate at which a specified air contaminant from an emission source would be emitted to the outdoor atmosphere in the absence of any control equipment. After your Emission Rate Potential is established, then DEC will apply a rating of A, B, C, or D to

each contaminant that is emitted at your facility. This rating (A being the most toxic) is assigned to each contaminant in order to consider the potential environmental effects of an air contamination source on its surroundings. Most of the industry general process emissions would fall under this category.

It should be noted that the Part 212 system for using Emission Rate Potential and Environmental Ratings to determine control requirements is likely to be changed in an upcoming amendment to Part 212.

Is Your Facility Subject To Control Requirements

PART 226 - SOLVENT METAL CLEANING PROCESSES

When cleaning computer components with a VOC solvent in a solvent cleaning machine, you are subject to Part 226 if your facility uses a conveyorized degreaser greater than 22 square feet of air/vapor interface; or an open-top vapor degreaser greater than 11 square feet of open area; or cold cleaning degreasing.

Chlorofluorocarbons (CFCs) were commonly used as a cleaning solvent in the electronics industry. However, Title VI of the federal regulations prohibited the use of CFCs after January 1, 1996. Many electronics facilities are now using mineral spirits, glycol ethers, or other solvents that contain no CFCs.

Solvent cleaning processes utilizing 1,1,1 trichloroethane (methyl chloroform), and methylene chloride are specifically exempt from Part 226. However, these solvents are

still regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAP) federal standard for solvent cleaning machines. Perchloroethylene is also exempt from Part 226 because EPA delisted it as a VOC. See page 22 for additional information on NESHAP.

Your facility can not conduct solvent metal cleaning operations unless:

- # Solvent is stored in covered containers and waste solvent is transferred or disposed of in such a manner that less than 20 percent of the waste solvent (by weight) can evaporate into the atmosphere.
- # Equipment used in solvent metal cleaning is maintained to minimize leaks and fugitive emissions.
- # Equipment used in solvent metal cleaning displays a conspicuous summary of proper operating procedures consistent with minimizing emissions of VOCs.
- # Equipment covers are closed when the solvent metal cleaning unit is not in service.
- # A record of solvent consumption shall be maintained for each year and made available to DEC upon request.

PART 228 - SURFACE COATING PROCESS

If your facility has a surface coating process that is used to coat capacitors or other electronic parts, then your facility must limit VOC emissions from all subject surface coating processes in order to comply with the VOC limits found in Part 228. Compliance strategies include high solids coating, ultraviolet coating, waterborne coating, and powder coating systems.

If low VOC coatings are not available to your facility, you can comply with Part 228 by installing VOC control equipment such as thermal oxidizers or carbon adsorption units.

The location of your facility and the amount of your VOC emissions will determine if you are subject to Part 228:

- # If your facility is located in the New York City Metropolitan Area, regardless of its annual potential to emit (PTE) VOCs, you must comply with Part 228.
- # If your facility is located in the Lower Orange County Area and coats products included in Table 1 of Part 228 and has a PTE \$10 tons VOC/year, or coats products included in Table 2 of Part 228 and has a PTE \$25 tons VOC/year, you are subject to Part 228.
- # If your facility is outside the New York City Metropolitan Area or the Lower Orange County Metropolitan Area and coats products included in Table 1 of Part 228 and has a PTE \$10 tons VOC/year, or coats products included in Table 2 of Part 228 and has a PTE \$50 tons VOC/year, you are subject to Part 228.

PART 234 - GRAPHIC ARTS

If your facility does any packaging rotogravure, publication rotogravure, flexographic, offset lithographic printing process, or screen printing process, Part 234 may require that you limit VOC emissions from these processes. If low VOC inks, fountain solutions or solvents are not available to your facility, you can comply with Part 234 by installing VOC control equipment such as thermal oxidizers or carbon adsorption units.

The location of your facility and the amount of your VOC emissions will determine

if your are subject to Part 234:

- # If your facility is located in the New York City Metropolitan Area, regardless of its annual potential to emit (PTE) VOCs, you must comply with Part 234.
- # If your facility is located in the Lower Orange County Area and has a PTE exceeding 25 tons VOC/year, you are subject to Part 234.
- # If your facility is outside the New York City Metropolitan Area or the Lower Orange County Metropolitan Area and has a PTE exceeding 50 tons VOC/year, you are subject to Part 234.

Part 234 does not apply to:

- # Conductive inks that are applied at screen printing processes in the production of electronic circuits that permit electric current flow through the printed line or pattern;
- # Inks which are applied by proof presses; or
- # Low-use speciality inks and/or coatings where the facility's total annual usage is equal to or less than 55 gallons provided that the conditions stated in Part 234.1(h)(4) are satisfied.

National Emission Standards for Hazardous Air Pollutants

Under Title III of the Clean Air Act, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAP) oriented towards controlling particular hazardous air pollutant (HAP) emissions.

The NESHAP regulation, 40 CFR Part 63 Subpart T, is EPA's solvent cleaning air toxics regulation that regulates halogenated solvent cleaning machines using any solvent containing methylene chloride, perchloroethylene, trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, or chloroform, or any combination of these



Figure 5 *This printing press stamps the company name on the electronic part that is manufactured at the facility. Presses such as these may be exempt from certain air regulations. Check with your DEC office if you need to determine what regulations apply to your facility or see Section V for a list of other assistance providers.*

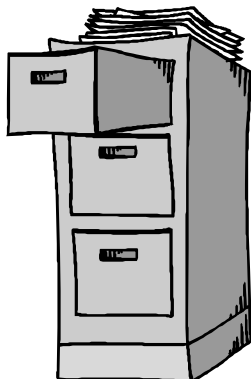
halogenated HAP solvents in a total concentration greater than 5 percent by weight as a cleaning and/or drying agent. The concentration of these solvents may be determined using EPA method 18, material safety data sheets, or engineering calculations.

Any owners and operators of solvent cleaning machines greater than 2.0 gallons, at any size facility that uses one of the six solvents listed above is affected by this regulation.

Owners and operators of batch cold cleaning machines have special provisions under this regulation. How you are affected depends on the type of solvent cleaning machine you use and the compliance option that you choose. The EPA estimates that full compliance with this new regulation will reduce air emissions of these toxic solvents by 85,300 tons annually.

Any operator of a batch vapor or in-line solvent cleaning machine that chooses the **equipment standard** may be asked to take an operator's test by EPA or an EPA designee during an inspection. This short test on operating procedure requirements must be completed and passed. If you choose the **overall emission limit**, you must meet the appropriate limit and there are no equipment, work practice, or operator test requirements. Operators of batch cold cleaning machines are not required to take this test.

Wipe cleaning activities, such as using rags containing halogenated solvents or spray cleaner containing halogenated solvents are not covered under the provisions of this Subpart.



RECORD KEEPING

Even if your facility is exempt from minor facility registration or air permitting requirements, you should still maintain records of your VOC emission rates even if you use fewer than 25 gallons per month.

By keeping these records, you will:

- # Show proof of compliance with applicable DEC air requirements.
- # Be able to determine if your shop needs any registrations or permits.
- # Be prepared to provide information to any Regional DEC inspectors if, and when, they call to visit your shop.
- # Help your shop toward implementing a pollution prevention program.

One of the easiest ways to keep records of your VOC emissions is by keeping your purchase order invoices for all the paints, lacquers, solvents, or additives used by your facility. Don't forget to obtain a copy of the MSDS for each of the materials that you purchase. If requested, most manufacturers will fax or mail copies of MSDSs within a day or two.

HOW TO CALCULATE YOUR VOC EMISSIONS

In order to determine what type of registration or permit your facility requires, you will need to know your total VOC emissions. To calculate your VOC emissions, you need to know your total annual usage of materials (e.g., paints, lacquers, makeup solvents, cleanup solvents, etc.). As discussed in the previous section, this information can be obtained from your purchase order records. Also, if any other additives or solvents are used in your shop that contain VOCs, such as isopropyl alcohol, the emissions from these

materials should be accounted for in your calculations.

VOC emissions are equal to the annual usage rate of the materials applied, times the VOC content at the time of application.

Here's how to calculate your total annual VOC emissions for paints, lacquers, makeup solvents, and cleanup solvents:

Multiply your annual usage rate (gallons) of paints, lacquers, makeup solvents, and cleanup solvents by the density in pounds per gallon (from MSDS or technical data sheet) of paints, lacquers, makeup solvents, and cleanup solvents by the weight fraction of VOCs in paints, lacquers, makeup solvents, and cleanup solvents.

Note: Density = specific gravity X 8.34 lbs./gal. Weight fraction is the percent by weight divided by 100 which can be obtained from the MSDS or technical data sheet.

Here is an example of how an electronics facility with a surface coating operation calculated some of their VOC emissions:

Example: Charles Capacitor Shop uses 130 gallons a year of coatings and lacquers, 52 gallons/year of thinners, and 20 gallons/year of cleanup solvents. The Material Safety Data Sheets (MSDSs) lists the VOC content at: coatings and lacquers - 5.0 pounds/gallon, thinners - 6.5 pounds/gallon, and cleanup solvents - 7.0 pounds/gallon.

VOC = Annual Usage x VOC Content at Application

Paints and Lacquers

Annual Usage = 130 gallons

VOC Content = 5.0 pounds/gallon

VOC = (130 gallons/year) (5.0 pounds/gallon)

VOC = 650 pounds/year

Thinners

Annual Usage = 52 gallons

VOC Content = 6.5 pounds/gallon

VOC = (52 gallons/year) (6.5 pounds/gallon)

VOC = 339 pounds/year

Cleanup Solvents

Annual Usage = 20 gallons

VOC Content = 7.0 pounds/gallon

VOC = (20 gallons/year) (7.0 pounds/gallon)

VOC = 140 pounds/year

Total VOC Emissions

Charles Capacitor Shop's total annual VOC emissions is 650 + 339 + 140 = 1129 pounds.

In addition to the coatings, lacquers, thinners, and cleanup solvents, your facility may be working with primers, multi-coating, precoat, and specialty coatings. You should check the MSDS for the VOC content of these materials. Call the product manufacturer or your distributor if you need copies of these MSDSs.

If you are an electronics facility with fewer than 100 employees and need assistance in computing your VOC emissions, finding out what registration/permits you need, or whether 6 NYCRR Parts 212, 226, 228, or 234 applies to your facility, call the Small Business Assistance Program (SBAP) at (800) 780-7227. This non-regulatory program provides *free* confidential technical assistance to help small businesses achieve voluntary compliance under the Clean Air Act.

Water Regulations

OVERVIEW

The electronics/computer industry must satisfy the following federal technology-based effluent limitation guidelines:

- # 40 CFR Part 469 applies to discharges from all processes associated with semiconductor manufacturing except sputtering, vapor deposition, and electroplating.
- # 40 CFR Part 433 applies to manufacturing facilities that perform any of the six metal finishing operations: chemical etching, milling, electroplating, electroless plating, anodizing, coating, and printed wiring board manufacturing.
- # 40 CFR Part 433 applies to discharges associated with the manufacturing of PWBs, except indirect discharging job shops and independent PWB manufacturers who discharge to POTWs, which are covered under Part 413.
- # 40 CFR 469, Subpart C applies to discharges from CRT manufacturers.
- # 40 CFR Part 469.34 applies to pretreatment discharges from existing CRT manufacturers.
- # 40 CFR Part 469, Subpart D applies to discharges from the manufacturing of luminescent materials which are used in coatings in fluorescent lamps, and CRTs. Luminescent materials include, but are not limited to: calcium halophosphate, zinc sulfide, and zinc-cadmium.
- # 40 CFR Part 469.43 applies to

pretreatment discharges from new sources of luminescent material manufacturers.

- # 40 CFR Part 413 applies to electroplating of common metals, chemical etching and milling, and electroless plating.

Remember

Before discharging oil and grease, solvents, acids, alkalides, or any other wastes generated at your facility to a municipal sewer system, check with your local POTW.

Wastes from the electronics/computer industry are mainly inorganic in nature. They may contain inorganic dissolved solids in the form of alkali metal salts together with heavy metal salts, cyanides, phosphates, sulfates, and chromates. In addition, wastes from this industry may contain organic matter in the form of oils and greases removed from parts (e.g., metal) in cleaning operations or as trace organic constituents of plating and cleaning solution rinses.

Plating chemical such as chromium acid, nickel sulfates, and zinc cyanide are among many solutions used throughout the electronics/computer industry during the plating process. Cleaning steps, plating baths, and rinsing are similar in most plating processes. However, proprietary variation may occur in formulation and process control parameters. All plating, both electroplating and electroless plating operations, must provide adequate rinsing after the plating bath to remove excess plating chemicals and contaminants that could cause spotting or staining on the product (workpiece). The water from the rinse is the major pollution control problem. In addition to managing the rinse water, there is the loss of valuable plating chemicals during the plating process.

Contaminants in the effluent from plating operations originate in several ways. One source of pollution is the **drag-out** of various processing baths into subsequent rinses. The amount of pollutants contributed by drag-out is a function of such factors as the design of the racks or barrels carrying the parts to be plated, the shape of the parts, plating procedures, and several other interrelated parameters of the process solution, such as concentration of toxic chemicals, viscosity, temperature, and surface tension. Conventional rinsing techniques may result in large volumes of rinse water being contaminated with cyanide and metals.

One method of reducing drag-out is by using wetting agents, or surfactants, in process tanks to aid in the plating process. These agents reduce the surface tension of a liquid causing it to spread more readily on a solid surface. The addition of very small amounts of surfactants can reduce surface tension considerably. It has been estimated that the use of surfactants can reduce drag-out loss by approximately 50%.

Another source of effluent contamination is discarded process solutions. These solutions are primarily spent alkaline and acid cleaners used for surface preparation of parts before plating.

Accidental spills, leaks, and drips of process solutions can also contribute significantly to effluent contamination. Usually tanks do not spring a leak that would allow the entire solution to leak away undetected. However, a slow leak amounting to a solution loss of 10 to 20 gal/day could go undetected for weeks in some shops.

CAN YOU TREAT OR RECYCLE

YOUR WASTEWATER?

Wastewater treatment processes and recovery processes can be considered treatment of a hazardous waste if the wastewater is a listed or characteristic hazardous waste. In order to avoid obtaining a permit under the hazardous waste regulations, your process must meet one of the exemptions found in 6 NYCRR Part 373-1.1(d)(1). Processes that comply with certain conditions are eligible for exemptions such as the wastewater treatment unit and the recycling exemptions. Alternately, the wastewater itself could be excluded from being a hazardous waste, such as the closed-loop exclusion.

PERMITTING REQUIREMENTS

If your facility discharges wastewater directly into surface or groundwaters, then you are required to obtain a State Pollutant Discharge Elimination System (SPDES) Permit. These permits are regulated under 6 NYCRR Parts 750-758.

A SPDES permit will list all pollutants your facility is discharging into surface or groundwater that DEC determines necessary to address. It may contain limits, action levels or monitoring for each pollutant. Limits applied to your discharge will be the more stringent of either technology-based limits (sometimes referred to as best available technology or BAT limits), water quality limits, or groundwater effluent standards. Water quality limits are calculated according to the classification and ambient standards assigned to the specific water body receiving the discharge. All surface waters and groundwaters in NYS are classified according to the best usage, e.g., drinking water or fish propagation.

To make certain you are complying with your permit limits, you may be required to

sample your discharge and submit monitoring reports. Contact your regional DEC office for information on obtaining a SPDES permit. A list of DEC regional offices can be found in Section V, page 75, of this manual.

PRETREATMENT PROGRAM

EPA's goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into the sewer system. As a result of regulating the discharge into publicly owned treatment works (POTWs), it will ultimately protect the quality of sludge that is generated from these plants. If you discharge wastewater directly into a municipal sewer system, you should check with your local POTW for discharge requirements. There may be certain restrictions, in addition to pretreatment requirements, for the discharge of wastewater into POTWs.

In most instances, electronics facilities are required to meet federal metal finishing pretreatment standards prior to discharge into a municipal sewer system. Under the National Pretreatment Program (40 CFR Part 403), electronic/computer facilities must monitor their compliance with the pretreatment standards that apply to their facility. Two types of monitoring and reporting are required. A one-time baseline monitoring report, or a semi-annual continued compliance report. The baseline monitoring report is only required when a new facility is coming on line and must be filed with your POTW at least 90 days before the facility's first discharge. The baseline monitoring report must provide basic information about your facility, its processes, waste treatment system, and discharge characteristics. Also, you must estimate the characteristics for all the regulated metals and for toxic organics that would reasonably be

expected to be discharged. In addition to the monitoring required under the national pretreatment program, you may be required to do more frequent monitoring under your local sewer use ordinance. Check with your POTW for your requirements.

The federal effluent guidelines, 40 CFR Part 433, apply to indirect dischargers that conduct any of the following operations:

- # Electroplating
- # Electroless plating
- # Anodizing
- # Coating (chromating, phosphating, and coloring)
- # Chemical etching and milling
- # Printed circuit board manufacturing

If your facility performs any of these operations, then the wastewater from these operations as well as the wastewater from any of 40 additional process operations you conduct (i.e., cleaning, polishing, brazing, vapor plating, assembly, soldering, grinding, sputtering, painting, testing, vacuum metalizing) must meet the numeric limits established under Part 433 guidelines. Contact your POTW if you need a list of these numeric limits.

The electronics/computer industry must test for all 126 priority pollutants listed in 40 CFR 122. Some priority pollutants that are likely to be discharged by facilities in the electronics/computer industry include: copper, lead, lead compounds, silver, chromium, and trichloroethylene.

In addition, testing is required for non-conventional pollutants likely to be discharged by the electronics/computer industry. Examples include: butyl acetate, xylene, formaldehyde, tin (total), nitrate/nitrites, titanium (total), and chlorine residual (total).

EPA has developed technology-based

standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. In the case of the electronics/computer industry, EPA developed nationwide pretreatment standards that would be applicable for this industry. In addition, there are local limits that are developed by your local POTW in order that the POTW can achieve the effluent limitations that are written in its SPDES permit.

Types of Treatment

The types of treatment may vary depending on the size of the facility and the type of electronic component that is being manufactured. Conventional wastewater treatment may consist of the following unit processes:

- # Chromium reduction of segregated chromium waste streams to reduce the chromium from its hexavalent form to the trivalent state, which then can be precipitated as chromium hydroxide by alkali neutralization.
- # Cyanide oxidation of segregated cyanide-bearing waste streams to oxidize the toxic cyanides to harmless carbon and nitrogen compounds.
- # Adjusting the pH of the combined metal-bearing wastewaters, acid/alkali wastewaters, strong chemical dumps, and the effluent from the cyanide and chromium treatment systems to precipitate the dissolved heavy metals as metal hydroxides.
- # Clarification where flocculating or coagulating chemicals are added to promote the initial setting of the precipitated metal hydroxides.
- # Gravity thickening over extended time to increase solids content of sludge before disposal.

- # Adjust pH to permitted ranges, if needed.

There are instances when an alternative treatment process is necessary to overcome the problems encountered in treating waste streams in the conventional manner. One problem that arises is the inability of the hydroxide neutralization/metal precipitation process to reduce the solubility of dissolved metals to the low levels required for discharging to the POTW. The problem arises because many plating wastewaters contain compounds that interact with dissolved metals and interfere with their precipitation as metal hydroxides. Such compounds as ammonia, ethylenediaminetetraacetic acid (EDTA), phosphates, and tartrates are commonly used in plating operations and consequently find their way into the wastewater. These compounds, called chelates, combine with the dissolved metal ion to form a complex ion that is relatively soluble in neutral or alkaline solutions.

Sulfide precipitation is one method of treatment that can be used to precipitate out metals as sulfides instead of hydroxides. This has been found capable of achieving low levels of metal solubility in highly chelated waste streams. Also, ion exchange has proven effective in lowering the metal concentration in wastewater discharge.

RECOVERY PROCESSES

As mentioned previously, the pretreatment regulations were developed in order to prevent the introduction of pollutants into a POTW. They also encouraged industrial dischargers to improve opportunities to recycle and reclaim municipal and industrial wastewater and sludges. With the introduction of pollution prevention, more and more facilities have given attention to reducing the magnitude of

their effluent discharges. Whether your facility discharges to a POTW, to surface waters, or groundwaters via a SPDES permit, there are various processes you can use in order to minimize wastewater flow. Your facility can save money by reducing the quantity of chemicals they are discharging, or by reducing the volume of flow. To accomplish this, electronic/computer manufacturers are trying to recover rinse water at their facilities by using processes such as: evaporation, reverse osmosis, ion exchange, electrolytic metal recovery, and electrodialysis. These processes all operate on the same basic principle - they concentrate the dragged-out plating solution contained in the rinse water to the degree that the solution can be returned to the plating bath. Their use can result in an essentially closed loop system around a plating bath where no chemicals are consumed other than those plated on the ware, and no rinse water is sent to waste treatment. Under very favorable conditions, a recovery system can achieve zero effluent discharge.

Using a recovery system requires the volume of rinse water to be reduced to a quantity that can be processed economically. Therefore, the use of a multistage counterflow rinse system is recommended.

Evaporation

Evaporation is used to recover a variety of plating bath chemicals by separating water from dissolved solids such as heavy metals. Recovery is accomplished by boiling off sufficient water from the collected rinse stream to allow the concentrate to be returned to the plating bath. The boiling condensed steam is recycled for use as rinse water in the rinse tanks. The evaporation is usually performed under a vacuum to prevent any thermal degradation of additives in the plating solution and to reduce the amount of energy consumed

by the process. This energy-intensive technology is expensive when large volumes of water are treated. Instead, evaporators are more economical when small amounts of water are used and the product concentration is high.

In an EPA documented case, it was shown that evaporators at one facility reduced waste generation by 50% and all plating chemicals were recovered. Prior to implementing the two evaporators, rinse water was treated with neutralization, flocculation, clarification, settling, filtration, and compaction. The capital cost for the two evaporators was \$12,5000 and the operation/maintenance costs were \$24,741. The payback period was 7 months.

Reverse Osmosis

Reverse osmosis is a pressure-driven membrane filtration process in which a semi-permeable membrane permits the passage of purified water under pressure, but does not allow the passage of larger molecular components. Water that passes through the membrane is usually recycled as rinse water. Water that is rejected by the membrane (e.g., dissolved solids) is returned directly to the process tank. Reverse osmosis can remove up to 98% of the dissolved solids, 99% of organics, and 99% of bacteria.

Several disadvantages of this technology include: sensitivity to hard water salts, problems with membrane durability, fouling of membrane because of feeds high in suspended solids, and feed filtration is essential.

Ion Exchange

This technology can be used for treating raw water to produce high-quality rinse water, recovering chemicals from rinse water, treating plating baths to remove contaminants, or end-of-pipe treatment.

Ion exchange is a process in which a chemical solution is passed through a bed of resin that selectively removes either the positively charged cations (e.g., Cu^{+2} , Fe^{+2}) or the negatively charged anions (e.g., CrO_4^{-2} , CN^-) from the solution. Anion resins exchange hydroxyl ions for negatively charged ions such as chromates, sulfates, and cyanides. Cation resins exchange hydrogen ions for positively charged ions such as nickel, copper, and sodium. The recovered metals are returned as metal salt solution. Ion exchange is used in the electroplating industry to remove trace pollutants from wastewater after a conventional treatment process or to recover plating solution drag-out from rinse water and to return the purified water for reuse.

The exchange resin is regenerated by passing a concentrated solution of the original ion through the resin bed. Rinsing is accomplished by circulating deionized water through the ion exchange column. The metals are recovered by cleaning the resin with an acid or alkaline solution.

A major drawback of ion exchange is that the resin must be regenerated after it has exhausted its exchange capacity. This complicates the operation of the system and results in small volumes of wash solution that adds to the waste treatment loading.

Electrolytic Metal Recovery

Electrolytic metal recovery is capable of recovering greater than 90% of the available metals in gold, silver, tin, copper, zinc, solder alloy, and cadmium plating operations. This process works by placing two electrodes (an anode and a cathode) in the solution so that the ions in the solution move toward the charged electrode. The dissolved metal ions are reduced and deposited on the cathode and

then removed by mechanical or chemical means. This material is sent off-site for refining, recycling, or disposal.

This process requires low maintenance, is energy efficient, and results in nonhazardous products. However, solution concentration should be monitored and the solution should be heated to maximize efficiency.

Electrodialysis

This process is used to reclaim nickel and gold from plating rinse waters by returning minimal amounts of unwanted inorganic material. This process uses both anion and cation charged membranes between a set of non-corrosive electrodes. When the contaminated rinse water is re-circulated between the charged surfaces, salts containing the metals are retained and returned to the plating tank. Rinse water is re-used in the drag-out or dirtiest rinse tank. As discussed previously, drag-out is the material that adheres to the workpiece when it is removed from a bath.

Even though this process recovers higher concentrations of ions than reverse osmosis or ion exchange, it is sensitive to clogging and ruptures, and the efficiency drops as the purity increases. One advantage of electrodialysis is its ability to retard the recovery of certain organics, especially nickel, that build up in some baths. This can reduce the frequency of bath purification.

STORM WATER MANAGEMENT

In 1987 under the Clean Water Act, EPA established a program to address storm water discharges associated with industrial activity.

The term “storm water discharge associated with industrial activity” refers to a storm water discharge from one of 11 categories of industrial activity defined in 40 CFR 122.26. Five of the categories are defined by SIC codes while the other six are identified through narrative descriptions of the regulated industrial activity.

All electronic/computer facilities that are subject to the general storm water permit will fall into Category xi because they have a standard industrial code of 36, and may fall into Category i because this category includes any facility, regardless of size, that is subject to toxic pollutant effluent guidelines.

Storm water permits are required when water from your facility is conveyed to a surface water body. If your facility’s storm water discharge goes directly into a combined storm sewer and sanitary sewer system that conveys the storm water to a POTW, then your facility may not need a general storm water permit. Check with your regional DEC office to determine if your facility is exempt from obtaining a storm water permit.

When rain or melting snow falls on industrial sites, it can pick up heavy metals, oil and grease, nutrients, and other pollutants, which usually flow undisturbed into water bodies. Storm water permits will help DEC recognize what wastes may eventually end up in the State’s waterways. To this end, DEC issues storm water permits that cover discharges from roads with drainage systems, catch basins, curbs, gutters, ditches, man-made channels, or storm drains which are used for collecting and conveying storm water which is directly related to manufacturing, processing, or raw material storage areas at industrial facilities.

The two types of storm water permits that are issued by DEC are individual or general permits. Individual permits are more complex

and require substantial data collection and reporting compared to applying for a general permit. Your facility can apply for a general permit by following the procedure below:

- # First, submit a “Notice of Intent, Transfer, Termination” (NOITT) to: DEC, 50 Wolf Road, Albany, NY 12233, Attention: Ken Stevens
- # Second, develop and implement a “**Storm Water Pollution Prevention Plan.**” In order to do this, you must obtain a copy of the *SPDES General Permit for Storm Water Discharges*. You can get a copy by calling your DEC Regional office (see Section V for the location of your regional office). The Storm Water Pollution Prevention Plan can be written by yourself or you can have a consultant prepare it for you. This plan does not have to be submitted to DEC, but must remain on premises in case a DEC inspector needs to review it.
- # General permits may require some type of monitoring depending on the type of facility. Usually electronic/computer facilities may only be required to do visual monitoring.

Call DEC at (518) 457-0624 if you have any questions on the storm water management program.

SAFE DRINKING WATER ACT

The Safe Drinking Water Act (SDWA) authorizes EPA to protect underground

sources of drinking water through the control of underground injection of liquid wastes. EPA accomplishes this by the federal Underground Injection Control (UIC) program. Under this program EPA requires owners and operators of facilities that discharge non-sanitary wastewaters to groundwater to (1) either close the cesspool, drywell or septic system, or (2) obtain a permit under the UIC program.

If your facility has any discharges to floor drains that are not connected to a municipal sewer system or to holding tank(s), then you might be in violation of the Environmental Conservation Law (ECL) and/or the federal UIC regulations. Similarly, if your facility's wastewater treatment system is discharging any wastewater to surface or groundwater without a State Pollutant Discharge Elimination System (SPDES) permit, this would constitute a violation of the SDWA Act and the ECL unless authorized by a UIC or SPDES permit. For further information on floor drains, see Section III, page 49.

EPA sets drinking water standards (maximum contaminant levels or MCLs) as required under the Safe Drinking Water Act. In order to protect New York State's drinking water, the NYS Department of Health (DOH) sets MCLs for drinking water. The State MCLs must be at least as stringent as the EPA MCLs. When DEC establishes ambient water quality standards and guidance values for surface waters and groundwaters, the DEC standard or guidance value must be at least as stringent as the DOH MCL. However, the DEC standards can be, and often are, more stringent than the DOH MCLs.

Hazardous Waste Regulations

OVERVIEW

The New York State hazardous waste regulations are covered under 6 NYCRR Parts 370-374 and 376 and apply to any business that generates hazardous waste. This includes, but is not limited to the electronics and computer industry that manufacture semiconductors, printed wiring boards, and cathode ray tubes.

Reminder

If you do not have a copy of the manual

Environmental Compliance and

Pollution Prevention Guide for Small

Quantity Generators, you can get your copy by calling DEC at (800) 462-6553.

No matter what wastes you dispose of, it is your responsibility to determine the type and quantity of hazardous waste you generate and properly manage it. Since disposal fees for hazardous waste can be very expensive, it would be in your best interest to practice good hazardous waste management. Call the DEC Pollution Prevention Hotline toll free at (800) 462-6553 for assistance with managing your hazardous waste. Refer to Section V for more information on technical assistance providers.

Don't Forget
Always keep good records of all the hazardous waste your facility generates.

Here are some hazardous wastes commonly generated by the electronics industry:

- # Industrial wastewater
- # Heavy metal wastes
- # Ignitable wastes
- # Solvent wastes
- # Toxic wastes
- # Still bottoms
- # Reactive wastes
- # Acids/bases
- # Sludges
- # Rags

DO YOU GENERATE HAZARDOUS WASTE?

If you generate waste at your facility, you should determine which wastes are hazardous. As a good management practice, you should always keep non-hazardous waste separate from your hazardous wastes. This will reduce or eliminate the mixing and/or contamination of wastes which could increase your disposal costs.

One way to make a hazardous waste determination is to see if your waste is listed in the New York State regulations, 6 NYCRR Part 371. If your waste is listed, it is hazardous. If your waste is not listed in Part 371, it could exhibit a hazardous waste characteristic such as: ignitability, corrosivity, reactivity, or toxicity according to the methods explained in 6 NYCRR Parts 371 and 372.

You can also apply your

knowledge of the waste to determine if it exhibits a hazardous characteristic. You must have a basis for making this determination such as material safety data sheets (MSDSs) or past analytical results. MSDSs may contain important information such as ignitability (flashpoint), corrosivity, or reactivity for substances or chemicals that you may use at your facility. Please note that MSDSs only describe the new product. Due to use of the product, the waste may become a hazardous waste, e.g., mixing or contamination.

H A Z A R D O U S W A S T E DETERMINATION

As mentioned previously, if your waste is listed in 6 NYCRR 371.4 (Hazardous Waste Regulations), then you know that you must manage this waste as a hazardous waste. If, however, it is not listed, then your facility must make a hazardous waste determination on that waste. If you are a business that generates hazardous waste, you should understand the term since it may apply to some of the waste streams mentioned in Section III. If you have not read the DEC manual, *Environmental*

Knowledge

If you are certain that a specific waste that you generate is not a hazardous waste because of your knowledge about this waste, then you can dispose of this waste as a solid waste. However, it is your responsibility to make this determination and you will be liable for any illegal disposal of hazardous waste if your

Compliance and Pollution Prevention Guide for Small Quantity Generators, you should do so in order to familiarize yourself with the requirements and conditions for hazardous waste generators.

If you generate a waste at your facility that is not listed in 6 NYCRR Section 371.4 of the Hazardous Waste Regulations, you must then determine if that waste is hazardous by any of the following four characteristics: ignitability, corrosivity, reactivity, and toxicity.

Ignitability

If your liquid waste has a flashpoint of less than 140E F, it is hazardous. Examples include: parts cleaners, paint solvents, waste kerosene, and waste gasoline.

Corrosivity

If your waste has a pH of 2.0 or lower, or a pH of 12.5 or higher, it is hazardous. Examples include: lead-acid batteries, rust removers, caustic parts degreaser, and acid or alkaline baths or solutions.

Reactivity

If your waste is unstable and undergoes violent chemical reaction spontaneously or reacts violently with air or water, it is hazardous. An example would be pressurized cans.

Toxicity

If your waste is not ignitable, corrosive or reactive, then it might have to be tested for toxicity according to the methods explained in 6 NYCRR Parts 371 and 372, or in the federal regulations, 40 CFR Part 261. Examples include: painting wastes, paint booth filters, used shop towels or rags, oily wastes, oil absorbents, wastewater treatment sludges, and rinse water.

A toxicity test is done by having a representative sample of the waste tested by a certified lab where it is analyzed using a toxicity characteristic leaching procedure (TCLP) test. If the test exceeds any of the allowable standards listed in Table 1, page 35, then the waste is hazardous. For a copy of certified labs in New York State, call (800) 462-6553.

A waste that exhibits one or more of the above traits will be declared hazardous.

The following are examples of some plating wastes that are often hazardous:

- # wastewater treatment sludges;
- # spent plating bath solutions;
- # sludges from the bottom of plating baths;
- # spent stripping and cleaning bath solutions.

HAZARDOUS WASTE CATEGORIES

Once you have determined that your business generates hazardous waste, then it is necessary to determine your hazardous waste category status. Depending on the quantity and type of waste generated, and the amount of waste stored, you will be in one of the following categories: Conditionally Exempt Small Quantity Generator (**CESQG**), Small Quantity Generator (**SQG**), or Large Quantity Generator (**LQG**).

This section will give an overview of the requirements for CESQG's and SQG's but will not discuss in detail the requirements for the LQG category. Large Quantity Generators are

fully regulated under 6 NYCRR Parts 370-374 and 376 and are not discussed in detail in this manual. LQGs can obtain a copy of the regulations by calling (518) 457-0532.

CONDITIONALLY EXEMPT SMALL QUANTITY GENERATOR

A conditionally exempt small quantity generator (CESQG) **must** meet all of the following conditions in order to qualify for this generator status:

- # Generate no more than 220 pounds (approximately 28 gallons) of hazardous waste per calendar month.
- # Generate no more than 2.2 pounds of acute hazardous waste per calendar month.
- # Store no more than 2,200 pounds of hazardous waste on site at any time.
- # Store no more than 2.2 pounds of acute hazardous waste at any time.

A CESQG must comply with the following:

- # Identify its hazardous waste.
- # Comply with storage quantity limits.
- # Ensure proper treatment and/or disposal of its waste.
- # Ensure delivery of the waste to a treatment or disposal facility by bringing no more than 220 pounds of hazardous waste to the authorized treatment or disposal facility; or have the waste transported by a 6 NYCRR Part 364 permitted hazardous waste transporter.

Did You Know?

As a CESQG, you can transport up to 220 pounds of your own waste to a State approved facility.

Table 1

Toxicity Characteristic Leaching Procedure (TCLP)

The following are substances covered by the TCLP. The concentrations are not total amounts of the chemical in the waste, but concentrations in the TCLP leachate after the specific test is carried out.

Waste Code	Substance	CAS Number	TCLP Concentration Limit (mg/l)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D006	Cadmium	7440-43-9	1.0
D007	Chromium	7440-47-3	5.0
D008	Lead	7439-92-1	5.0
D009	Mercury	7439-97-6	0.2
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D012	Endrin	72-20-8	0.02
D013	Lindane	58-89-9	0.4
D014	Methoxychlor	72-43-5	10.0
D015	Toxaphene	8001-35-2	0.5
D016	2,4-Dichlorophenoxyacetic acid	94-75-7	10.0
D017	2,4,5-Trichlorophenoxypro pionic acid	93-72-1	1.0
D018	Benzene	71-43-2	0.50
D019	Carbon Tetrachloride	56-23-5	0.50
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D023	o-Cresol	95-48-7	200.0*

D024	m-Cresol	108-39-4	200.0*
D025	p-Cresol	106-44-5	200.0*
D026	Cresol	200.0*
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.50
D029	1,1-Dichloroethylene	75-35-4	0.70
D030	2,4-Dinitrotoluene	121-14-2	0.13**
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13**
D033	Hexachloro-1,3-Butadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D035	Methyl ethyl ketone	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0**
D039	Tetrachloroethylene	127-18-4	0.7
D040	Trichloroethylene	79-01-06	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D043	Vinyl Chloride	75-01-4	0.20

* If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200.0 mg/l.

** Quantitation limit is greater than the calculated regulatory level. The quantitation limit, therefore, becomes the regulatory level.

These TCLP standards were published by the United States Environmental Protection Agency (EPA) on March 29, 1990. The standards were effective for fully regulated hazardous waste generators on September 25, 1990. Since March 29, 1991, small quantity and conditionally exempt small quantity generators are also required by the USEPA to handle wastes that fail the TCLP as hazardous wastes. New York State adopted the TCLP, effective January 1995. To obtain a copy of the test procedures, you can call the Methods Information Communication Exchange at (703) 821-4690, or you can e-mail them at mice@lans828.ehsg.com.

A CESQG must ensure delivery of its hazardous waste to an offsite treatment or disposal facility that is:

- # A state or federally regulated hazardous waste management treatment, storage or disposal facility.
- # A facility permitted by NYS to manage municipal or industrial solid waste.
- # A facility that uses, reuses or legitimately recycles the waste.
- # A permitted household hazardous waste collection facility that accepts CESQG waste. See Section V for a list of participating municipalities.

SMALL QUANTITY GENERATOR

A small quantity generator (SQG) **must** meet all of the following conditions in order to qualify for this generator status:

- # Generate between 220 pounds and 2,200 pounds of hazardous waste per calendar month.
- # Generate no more than 2.2 pounds of acute hazardous waste per calendar month.
- # Store no more than 13,200 pounds of hazardous waste on site at any time.
- # Store no more than 2.2 pounds of acute hazardous waste at any time.

Did You Know?

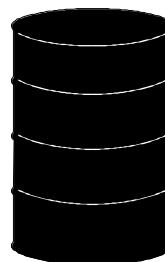
As a Small Quantity Generator, you **cannot** transport your own waste. You must use a 6NYCRR Part 364 permitted transporter.

A SQG Must Do The Following:

- # Obtain an EPA Identification Number by calling EPA at (212) 637-4106.
- # Submit a completed hazardous waste manifest form.
- # Use a 6 NYCRR Part 364 permitted hazardous waste transporter.
- # Limit on-site storage. Waste must be shipped within 180 days of accumulation, or 270 days if the treatment, storage, or disposal facility is greater than 200 miles away.
- # Follow emergency preparedness and response requirements.
- # Adhere to land disposal restrictions.

Storing Your Hazardous Waste

- # Keep the waste in a separate storage area which is labeled “**Hazardous Waste Storage Area.**”
- # Label all containers.
- # Mark each container with the date you began collecting waste in that container.
- # Use proper containment (pallets with built-in spill containment or berms) in case of leaks.
- # Keep containers closed when not in use.
- # Keep containers in good condition and periodically inspect for leaks, cracks or rust.



For more information on small quantity generators, request a copy of the manual, *Environmental Compliance and Pollution Prevention Guide for Small Quantity Generators* by calling (800) 462-6553.

Solid Waste Regulations

In 1988 the Solid Waste Management Act put emphasis on waste reduction, reuse and recycling as primary solid waste management methods.

Every electronics facility should be aware of what items they are discarding and how they are disposing of them. The best way to do this is to develop a solid waste management disposal plan for your shop. The first step in developing your plan is to conduct a waste audit of your business. A waste audit will show where you can improve your purchasing practices and help identify potential waste reduction and recycling options. Also, a waste audit will help you get accurate information on the nature and quantity of your waste. Businesses that implement waste reduction, reuse and recycling have benefitted by reducing costs.

Here are some waste reduction and recycling strategies your company can adopt:

- # Use reusable shipping containers and pallets.
- # Use minimal or reusable packaging.
- # Purchase reusable products and supplies.
- # Recycle your office paper, plastics, glass, metal and other materials that can be recycled in your company.
- # Make sure your employees practice waste reduction and recycling methods.
- # Purchase products with recycled content.

In addition, you may want to identify the materials that comprise the largest portion of your waste stream and establish a separate recycling program targeting the materials identified.

If you need a copy of the *Waste Audit Reference Manual*, call the DEC Bureau of Waste Reduction & Recycling at (518) 457-7337.

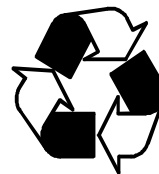


Figure 6 These electronic components are getting ready to be sent through a metal shredder. (IBM Photo)

ELECTRONICS/COMPUTER RECOVERY

Computers consist of materials such as plastic housing, glass screens (CRTs), metal conductors and wire switches, silicon chips, capacitors, and other items that may or may not be recycled. In the past, computers contained enough precious metals to allow for scrap metal to be recovered. In general, PWBs tend to be the main source of precious metals allowing for approximately 10 ounces of gold to be recovered from 1 ton of this material. Other metals that can be recovered from computers are platinum, silver, copper, steel, and aluminum.

Over the past several years, in an effort to reduce costs, the computer industry has cut its use of precious metals by as much as 90%. In addition, computer recyclers have become overwhelmed by the large amounts of plastic which makes it more difficult for these businesses to operate effectively.

Even though there are a number of reuse and recycling options for computers, they are still being disposed of in landfills and incinerators. Some computer manufacturers are starting programs to recycle used and new machines, parts, and CRTs and have noticed a considerable decrease in their solid waste disposal costs. One such facility is IBM Corporation located in Endicott, New York. In 1998, IBM's solid waste management program has diverted 8 million pounds of solid waste from landfills. Wastes that were recycled at their asset recovery operations center included: computer parts and equipment, paper, corrugated cardboard, miscellaneous plastic, wood pallets, plastic foam, and precious metals.

Discarded computer monitors, because of the lead content of the cathode ray tubes (CRTs) inside, could be a hazardous waste. See Section III under Cathode Ray Tubes. If you are discarding or collecting computer monitors, they must be managed in accordance with New York's hazardous waste regulations. This means that CRTs should not be thrown in the trash. If, however, these CRTs are going to an authorized reclamation facility to reclaim the scrap metal, they can qualify for the scrap metal exemption under the regulations. In order to utilize this scrap metal exemption, the facility must notify DEC pursuant to 6 NYCRR 371.1(c)(7).

Please note that mercury switches, relays, and NiCd or mercury batteries must be removed prior to such shipment to dismantlers or reclamation facilities and need to be managed separately as a newly generated waste.



Figure 7 *This PWB was just shredded along with other electronic components. If you are interested in recycling your computer components, look on the Internet under “computer recycling.” (IBM Photo)*

Bulk Storage Regulations

If your facility utilizes solvents, corrosives, etchants, heat transfer fluids, degreasers, petroleum products, etc., you may have to comply with State and federal bulk storage regulations. These bulk storage regulations pertain to tank registration, upgrades, and inspections for the safe handling and storage of over 1,000 different hazardous substances as well as stringent design standards for new construction.

HAZARDOUS SUBSTANCES

New York's chemical bulk storage (CBS) program addresses both underground (UST) and aboveground storage tanks (AST) containing regulated hazardous substances. In 1986, the state legislature passed the Hazardous Substance Bulk Storage Act, which required DEC to establish a program for preventing the release of hazardous substances into the environment. Phase I (6 NYCRR Parts 595, 596, and 597) of the CBS regulations was adopted on July 15, 1988 and established a list (Part 597) of chemicals to be regulated. These regulations (Part 596) required the registration of ASTs that exceed 185-gallon capacity and all USTs that store any of these hazardous substances either singularly or in combination.

Phase II was adopted on August 15, 1994. This phase modified Parts 595, 596, and 597 and established minimum requirements and schedules in Parts 598 and 599 for the design, construction, installation, operation, maintenance, repair, monitoring, testing, and inspection of storage facilities.

Regulatory Deadlines and Requirements for Facility Upgrade

Part 598 establishes the upgrade requirements for USTs with a deadline of December 22, 1998 (the same as EPA's UST program) and for ASTs with a deadline of December 22, 1999. Facilities constructed after February 11, 1995 must meet the standards for all new or

substantially modified facilities (Part 599). The installation of a new tank, even a replacement tank, is considered a substantial modification. Repairs and replacements to ancillary piping, vents, gauges, pumps, etc., are not considered substantial modifications.

USTs are required to be (1) corrosion resistant, which consists of cathodically-protected steel, fiberglass-reinforced plastic, or a combination of both, and must have (2) secondary containment with interstitial monitoring for leak detection.

If the tank is not double-walled, it must be installed inside an excavation liner to contain any releases. All USTs must be equipped with spill and overfill prevention devices to include high-level alarms or automatic shutoff devices, spill catchment basins at the fill-port, and secondary containment for the transfer station. Underground piping must be corrosion resistant and have secondary containment with interstitial monitoring.

By December 22, 1999, all ASTs must be upgraded. Tanks in contact with soil must be cathodically protected. Tanks constructed of materials which could melt when exposed to fire must be protected from fire. All ASTs must have secondary containment and be equipped with a product level gauge and either a high-level alarm, a high level trip, or an

overflow to a catch tank. The storage tank must be equipped with valves to control the flow of product for each tank connection.

Secondary Containment at Transfer Stations

A transfer station is an area where pipes or hoses are connected and disconnected to empty or fill a storage tank. This includes railways, roads, containment basins, curbs, collection sumps, and impervious pads where a vehicle or container is located to off-load or to receive a hazardous substance, where a coupling to a transfer line is made for the purpose of hazardous substance transfer, or where a system to collect and contain spills resulting from transfer is located. By December 22, 1999, all transfers of hazardous substances at a registered facility must occur within a transfer station equipped with permanently installed secondary containment. The goal of the program is to control any release from bulk storage systems and transfer operations and to reduce/eliminate releases to soil, surface water, and groundwater.

Spill Prevention Report (SPR)

The SPR is considered to be the cornerstone of the CBS regulations and was required after August 11, 1996. The major elements of the SPR require a listing of all spills over the previous five-year period, an assessment of the causes of those spills, a compliance assessment of bulk storage operations, records of inspections, a spill response plan, and management's signature indicating acceptance and approval of the report. A proper SPR can minimize and eliminate injury, loss of life, hospitalization, subsequent remediation, and reduce its overall liability.

PETROLEUM PRODUCTS

In 1983, the State Legislature enacted Article 17, Title 10 of the Environmental Conservation Law, entitled "Control of the Bulk Storage of Petroleum." The Law applies both to Underground Storage Tanks (USTs) and Aboveground Storage Tanks (ASTs), or groupings of such tanks with a combined storage capacity of more than 1,100 gallons. Exempted from this law because they are regulated under other programs are: oil production facilities; facilities licensed under the Navigation Law; and, facilities regulated under the Natural Gas Act.

Under 6 NYCRR 612-614 passed in 1985, owners were required to register storage facilities with DEC by December 27, 1986. Facilities must be re-registered every five years. Registration fees vary from \$50 to \$250 per facility, depending on capacity. Some 114,000 tanks, holding a total of nearly 4.4 billion gallons, are registered in New York. New facilities must be registered before being placed into service. DEC must be notified within 30 days prior to substantial modifications.

Nassau, Suffolk, Rockland and Cortland Counties administer the program in these localities, pursuant to delegation from DEC. Because these counties may have more stringent requirements than the State, owners and operators should contact the county to learn of specific local requirements.

All facilities regulated under Article 17, Title 10 must meet certain handling and storage requirements established by DEC. Existing USTs and ASTs must observe rules for color coding of fill ports, shutoff valves, gauges and check valves. Aboveground tanks must be provided with secondary containment (i.e., berms or other devices to contain spills). Operators of USTs must keep daily inventory records (and maintain them for five years) and notify DEC and the tank owner within 48

hours of unexplained inventory losses. They must also test tanks and pipes every five years or monitor the interstitial space of double-walled equipment. Operators of ASTs must conduct monthly visual inspections. Every 10 years they must clean out the tanks, remove the sludge from the bottom, inspect for structural integrity and test for tightness.

Tanks that are temporarily out-of-service (30 days or more) must be drained of product to the lowest draw off point. Fill lines and gauge openings must be capped or plugged. Inspection and registration must continue. Those tanks that are permanently out-of-service must be emptied of liquid, sludge and vapors and must either be removed or filled with solid inert material such as sand or concrete slurry. DEC must be notified 30 days prior to filling or removal.

Part 614 applies to all new and modified facilities. New USTs must either be made of fiberglass reinforced plastic; cathodically protected steel (to protect against the corrosion caused by contact between steel and soil); or steel clad with fiberglass reinforced plastic. Secondary containment such as a double-walled tank, a vault, a cut-off wall or impervious underlayment must be provided. Either monitoring of the interstitial space, an in-tank monitoring system or one or more observation wells is required. New ASTs must be constructed of steel. If their bottom rests on the ground, the tank must have cathodic protection. An impermeable barrier must be installed under the tank bottom, with monitoring between the barrier and the bottom. New underground piping systems must be designed with a 30-year life expectancy. If made of steel, they must be cathodically protected. Pipes may be constructed of fiberglass- reinforced plastic or other equivalent non-corrodible materials.

WHEN TO REPORT A SPILL?

Reporting spills is a crucial first step in the response process. There may be several different state, local, and federal laws and regulations that require spillers to report petroleum and hazardous materials spills.

Hazardous Substances

Associated with each regulated hazardous substance under Part 597 is a Reportable Quantity (RQ), one for a release to air and one for a release to land/water. Appropriate parties are required to take prompt remedial action to protect human health and the environment in the event of a spill. A spill that exceeds the RQ but is contained by effective secondary containment, and which is cleaned up within 24 hours, is not reportable unless it could result in a fire or explosion or pose a health risk to adjacent parties. When a spill cannot be contained, it becomes a release to the environment. When a release exceeds the RQ for that substance, the facility must report the release to the DEC Spill Hotline (800) 457-7362 within two hours of discovery. Part 595 applies to all releases, including those from chemical process tanks, chemical fires, explosions, and non-registered facilities.

Petroleum Products

Petroleum spills must be reported to DEC unless they meet **all** of the following criteria:

- # The spill is known to be < 5 gallons.
- # The spill is contained and under the control of the spiller.
- # The spill has not and will not reach the State's water or any land.
- # The spill is cleaned up within 2 hours of discovery.

All reportable spills must be reported to the DEC spills Hotline at 1-800-457-7362.

Section III - Waste Stream Management

To assist the electronics industry in complying with environmental regulations, this section will discuss some best management practices for waste streams that can be generated in this industry. Each waste stream listed will give the reader an interpretation of the DEC regulatory requirement and the preferred waste management techniques that facilities can try when they dispose of their waste.

Abrasive and Alkaline Cleaning Compounds

The most common cleaning solution used in the semiconductor and PWB industry is a combination of hydrogen peroxide and sulfuric acid. Most alkaline cleaning solutions are comprised of builders of hydroxides (e.g., NaOH) and carbonates (e.g., Na_2CO_3). Acid cleaning, or pickling, use solutions of sulfuric, hydrochloric, phosphoric, and/or nitric acids.

REGULATORY REQUIREMENTS

If your facility uses alkaline or acidic cleaning solutions, you must make a hazardous waste determination on the spent solution before disposing of this waste. If the pH of this waste is 2.0 or less; or 12.5 or greater, prior to any waste treatment, then these are hazardous wastes. In addition, these wastes could be hazardous if they fail the TCLP test for metals.

POLLUTION PREVENTION TIPS

Chemical substitution is one of the best ways to reduce your hazardous waste generation during your cleaning process. Here are some tips that could help you:

- # Use mild alkaline and acidic cleaners. Mild alkaline detergent solutions such as sodium hydroxide, sodium carbonate, sodium phosphate, and borax are used to clean many substrates because no

hydrogen gas is formed during the process. These cleaners also remove rust, scale, and oxides from metal surfaces. Generally, the stronger the solution, the faster it cleans. However, mild solutions are used to accomplish thorough rinsing in the process line.

- # Rinse water from an acid dip process can be piped to the alkaline cleaning process for use as rinse water. Make sure that the rinse tanks, pipes, plumbing, and bath chemistries are compatible.
- # Reuse spent acid cleaning rinse water as an influent for rinsing after a mild etching process.
- # Reuse rinse water from final or critical rinses in rinsing operations where a high degree of rinsing efficiency is not required.
- # Alkaline cleaners are typically discarded after the accumulation of oil, grease, and soils reach a level that impairs the cleaning efficiency of the bath. Several means are available for removing these contaminants and thereby extending the life of the bath. Free-floating oils can be removed by simple skimming devices. Particulates can be removed by settling and/or cartridge filtration. Some emulsified oil can be removed by an oil-water coalescer. However, the most effective means of alkaline cleaning bath filtration is to use microfiltration or ultrafiltration. With these membrane technologies, the emulsified oils from the cleaning bath are separated from the aqueous cleaning solution, resulting in a small residual of oily-water waste

- (typically 10% of the original bath volume) and a recycled cleaner requiring only fortification;
- # Solvent degreasing of workpieces before processing may be replaced by hot alkaline cleaning baths. Solvent use requires offsite recycling or disposal, or onsite recycling with only solvent sludge disposal offsite, whereas alkaline baths can be treated onsite. The effectiveness of alkaline cleaners can be enhanced by applying an electrocurrent or ultrasonics, and the benefits of avoiding solvent vapors and sludges often outweigh an additional operating costs.

For more information on abrasive and alkaline cleaning compounds, see this section under parts cleaning and degreasing.

Absorbents and Floor Dry

REGULATORY REQUIREMENTS

A hazardous waste determination must be made on all absorbent pads or floor dry material that is used to clean up spills. If your facility has a spill that could be harmful to public health or the environment, you must contact DEC immediately at (800) 457-7362.

POLLUTION PREVENTION TIPS

Good housekeeping practices are the best way to minimize spills. The fewer spills that occur, the less absorbents, floor dry or other absorbent material will be needed to clean up these spills. Here are some tips to help you prevent spills at your facility:

- # Train your employees. Since employees are the ones who create the spills, make sure that each employee is taught the importance of spill prevention.
- # If you must use absorbents, make sure to purchase absorbent material that can be reused. Absorbent “socks,” for example, can be used about 10 times.
- # Make sure all of your tanks or drums that contain liquids have some kind of containment in case of a leak or spill.
- # After wiping up a spill with absorbents or mop, drain excess liquids into the waste container for that particular waste. For example, if you are cleaning up an oil spill, squeeze the excess oil in the container marked *USED OIL*.
- # Use shop towels to wipe up small spills, then send your shop towels to be laundered.
- # You may want to consider an award program for employees that keep their work areas clean or for workers who come up with good pollution prevention ideas.

Alert
Before discarding absorbents or floor dry into dumpsters, make sure you are complying with all the necessary DEC regulations.

Acid Fumes

REGULATORY REQUIREMENTS

If acid fumes from acid cleaning operations and organic vapors from vapor degreasing operations are not contaminated with other materials, they should be kept separate for treatment.

Acid fumes are usually collected with chemical fume hoods and sent to a scrubber where the fume contaminants are removed with water. The scrubbed air is then passed on to the atmosphere, and the absorbing solution is sent to be neutralized.

If your facility generates acid fume emissions, you should contact DEC to determine if you need a scrubber for these emissions. Additionally, your facility may need an air permit in order to use this scrubber.

POLLUTION PREVENTION TIPS

- # Use a mist suppressant (chemical) on the surface of your bath solution which forms a barrier to prevent mist from escaping.



Figure 8 Acid fumes released from this tank may require a permit under 6 NYCRR Part 212.

Mist suppressants can be very effective (>95%) in reducing emissions from chrome plating and anodizing. A generic suppressant is not available for widespread use, therefore a different mist suppressant might be required for each bath to achieve the desired result. Mist suppressants can range from \$10 to \$60 per pound.

- # Use a wetting agent (surfactant) on your plating baths which reduces the surface tension, and in turn, will reduce the rate of mist generation. However, wetting agents can affect the quality of the deposits; too much can cause burning, pitting, or poor adhesion; too little can result in little or no reduction of emissions.
- # Use tank covers. Thin plastic sheets can be placed over the plating bath to reduce emissions. Plexiglass or other suitable plastic cut to fit the tank can also be used.
- # Meshpad mist eliminators are used to recover plating chemicals that are entrained in the exhaust gas from the plating tank. They are most commonly used with chromic acid baths, but are also used with caustic, cyanide, hydrochloric acid, nitric acid, and sulphuric acid baths. Mist eliminators are an alternative to scrubbers, and they are typically used in a dedicated manner, with one mist eliminator installed within the exhaust system duct work of each plating tank. This configuration makes return of the captured chemicals to the plating tank more feasible than with a scrubber which may service multiple exhaust streams.

Cathode Ray Tubes

REGULATORY REQUIREMENTS

Discarded computer monitors, because of the lead content of the cathode ray tubes (CRTs) inside, are very likely to fail a laboratory test called the Toxicity Characteristic Leaching Procedure (TCLP), and thereby meet the definition of hazardous waste as defined in Section II of this manual. All wastes, including discarded computer monitors, that are hazardous must be managed in accordance with New York's hazardous waste regulations. In those cases where hazardous monitors are to be simply "thrown out," those regulations totally prohibit their disposal in the trash. These monitors must be managed either as an "ordinary" hazardous waste (generally requiring manifesting, etc), or they may instead be sent in containers to authorized dismantlers or reclamation facilities without a manifest as long as the scrap metal pieces present in the monitors are ultimately reclaimed. It should be noted that most mercury switches, relays, and NiCd or mercury batteries must be removed prior to such shipment to dismantlers or reclamation facilities. These items must be managed separately as a newly generated waste.

Coating Operations

REGULATORY REQUIREMENTS

If your facility conducts spray painting operations, a hazardous waste determination must be made on waste paint, solvents/thinners, paint sludge, primer waste, and spray booth filters. The paints and paint sludges may be hazardous if they contain heavy metals, such as arsenic, lead and chromium. The solvents may be characteristically hazardous due to their ignitability or they could be a listed hazardous

waste. Also, many primers, lacquers, and enamels are flammable.

During spray painting operations, volatile organic compounds (VOCs) and hazardous air pollutants (HAP) are released into the environment. These pollutants are regulated under the Clean Air Act. To learn more about these requirements, refer to Section II, under the Air Regulations.

POLLUTION PREVENTION TIPS

Here are some tips on ways to minimize your waste from coating operations:



Figure 9 *Coating capacitors like the one seen here may require this facility to comply with VOC emissions under Part 228 and hazardous waste disposal requirements under the Part 370 series.*

- # Train employees on paint application techniques. Proper training in the correct use of applying paint can reduce your waste and VOC emissions.
- # Make sure your facility uses high-volume/low-pressure (HVLP) spray guns. These spray guns have transfer efficiencies of about 60 to 80 percent.
- # Train employees on the proper cleaning and maintenance of equipment. This is

essential in achieving a high quality finish, especially in the new spray guns.

- # Do all spray painting in an enclosed spray booth equipped with filters.
- # When cleaning spray guns with solvents, use smaller diameter tubing so that you will use less solvent.
- # The solvent that is used to clean spray guns can be reused to thin paint of the same color.
- # If possible, switch to water-based paints and primers.
- # Switch from lacquer to enamel-based paints. Lacquer paints may contain 70 to 90 percent solvent by volume, while enamels contain 55 to 75 percent solvent by volume.
- # Use solvents with low or no VOC content.
- # Purchase a small solvent distillation unit in order to recycle your paint thinners and solvents.

Etchant

REGULATORY REQUIREMENTS

Etching is sometimes used as a surface preparation technique prior to electroplating, or for removal of metal in the printed circuit board industry that is not required on the finished product. Etchants can consist of sulfuric and chromic acid, ammonia persulfate, hydrogen peroxide, cupric chloride, ferric chloride, or alkaline ammonia. Wastes generated during this process can contain ammonia, chromium, copper, iron, and acids.

Because of the solutions used during the etching process and the wastes that are generated, you must make a hazardous waste determination on your spent etchants to see if

they exhibit one or more hazardous waste characteristic mentioned in section II of this manual.

POLLUTION PREVENTION TIPS

Here are some tips that could try at your facility for your etching operations:

- # Using differential plating instead of the conventional electroless plating process can control the concentrations of certain stabilizers in the copper bath. During differential plating, copper deposits 3-5 times faster on the through-hole walls than on the copper clad surface. This reduces the amount of copper that must be etched away during the next step of the process.
- # Use non-chelated mild etchants such as sodium persulfate and hydrogen peroxide/sulfuric acid can be used to replace ammonium persulfate chelate etchant.
- # Use thinner copper foil to clad the laminated board which should reduce the amount of copper which must be etched, and thus reduces the amount of waste generated from the etching process.
- # Use pattern instead of panel plating. Panel plating consists of plating the entire board area and pattern plating requires copper electroplating of only the holes and circuitry. Pattern plating reduces the amount of non-circuit copper which must be subsequently etched away and, therefore, reduces the amount of waste generated from the etching process.
- # Use the additive instead of the subtractive method which eliminates the copper etching step. By eliminating the etching step, you will eliminate the generation of substantial volumes of spent etchant as well as reducing the amount of metal

- hydroxide sludge you generate.
- # Use non-chrome etchants whenever possible. Use ferric chloride or ammonium persulfate solution instead of chromic-sulfuric acid etchants.
 - # Recycle spent etchants whenever possible. The use of an electrolytic diaphragm cell oxidizes trivalent chromium to hexavalent chromium and removes contaminants.

Floor Drains and Wastewater

The wastewater discussed in this section refers to all wastewater that is generated at your facility that is not treated before it is discharged. This can include wastewater from spills, clean-up, leaks, or any other industrial wastewater that does not get treated.

REGULATORY REQUIREMENTS

As discussed in Section II, the Environmental Conservation Law prohibits the discharge of pollutants into surface or groundwaters without a State Pollutant Discharge Elimination System (SPDES) Permit. The Safe Drinking Water Act, under the Underground Injection Control program administered by EPA was designed to prevent contamination of groundwater resulting from the operation of injection wells. In addition, the disposal of hazardous waste illegally is a violation of the federal Resource Conservation and Recovery Act (RCRA).

Wastewater from electronics facilities may contain heavy metals, toxics, solvents, oil and grease, gasoline, and other materials that could be hazardous.

If you have floor drains at your facility,

you must do one of the following:

- # Make sure they are connected to a public sewer system. In most cases floor drains may be connected to a publicly owned treatment works (POTW), however, the owner should refer to the Local Codes Enforcement Officer and the Sewer Use Ordinance before making any new connections. Some municipalities restrict floor drains from being connected to the sewer system depending on the type of operation. Also, you may be required by your POTW to connect an oil/water separator between the floor drains and the sewer system. Oil/water separators should be checked on a regular basis to make sure they are working properly. This includes cleaning out the sludge annually, testing it for toxicity and then disposing of it properly. If you are a conditionally exempt small quantity generator (CESQG), you can transport this sludge to an approved facility. This includes transporting dried sludge to your local landfill. Prior approval is needed. See Section V for locations of the household hazardous waste collection facilities.
- # Make sure they are connected to some kind of holding tank where the wastewater can be pumped out and treated or disposed properly. All wastewater should be hauled away by a DEC 6 NYCRR Part 364 permitted waste transporter to avoid any liability.

POLLUTION PREVENTION TIPS

Wastewater can be generated at your facility from washing floors or some other cleaning operations. By minimizing the amount

of wastewater that is generated, you can reduce the amount of wastewater and sludge that must be managed or discharged. Here are some tips that could help you minimize your generation of wastewater:

- # Use dry floor cleaning methods. This includes sweeping and vacuuming.
- # Train employees to use water efficiently.
- # Use only non-toxic soaps to clean floors and vehicles instead of hazardous materials.
- # Prevent drips and spills from reaching the floor.
- # If a small spill does occur, clean it immediately with shop towels or mops. This was discussed in the shop towel section. Never clean spills by hosing them down with water.
- # Perform vehicle maintenance work in areas where there are no floor drains. If floor drains are present, seal them off during work to prevent spills from entering the drains.
- # Never have floor drains where hazardous materials are stored.
- # If you collect your wastewater in a holding tank, try to reuse it whenever possible.
- # You may want to consider buying a water recycling unit in order to treat your wastewater on site.
- # If your wastewater is nonhazardous, you may want to purchase evaporating equipment to evaporate your wastewater. It should be noted that evaporators may require an air permit or registration. In addition, evaporator bottoms may be a hazardous waste.
- # Wash your vehicles at an off-site commercial car wash.
- # If you service vehicles at your facility, brush snow and ice off vehicles before

bringing them into the shop for service.

Parts Cleaning and Degreasing

REGULATORY REQUIREMENTS

Spent solvents are dangerous to workers because they are toxic and they emit harmful vapors. If your facility still uses a parts washing system that contains a hazardous solvent, you may be generating listed hazardous wastes which will have EPA Hazardous Waste Codes of F001-F005. In addition, many solvents may be hazardous because of ignitability which will have an EPA Hazardous Waste Code of D001.

When using hazardous solvents in your parts washing system, you are required to keep track of the amount generated each month and dispose of them as hazardous waste. The following are some of the common spent halogenated and non-halogenated solvents used in degreasing operations that are considered hazardous:

Tetrachloroethylene (Perchloroethylene)
Methyl isobutyl ketone (MIBK)
Chlorinated fluorocarbons
Trichlorofluoromethane
Carbon tetrachloride
Ortho-dichlorobenzene
Methylene chloride
1,1,1-trichloroethane
Methyl ethyl ketone (MEK)
Methanol
Isobutanol
Toluene
Acetone
Xylene
Benzene

If your facility uses any of the above parts washing solvents or degreasers, or any other hazardous solvent not listed above, you should make every effort to look for a reliable substitute that is nonhazardous or less hazardous.

TYPES OF PARTS WASHERS

There are many opportunities available to minimize or eliminate your generation of hazardous solvents. One of your first choices should be to use a nonhazardous or less hazardous parts cleaning system. Here are some tips you should follow before purchasing or leasing your parts washer:

- # Buy a parts washer with a lid rather than an open bucket or pan. This will reduce evaporation or spillage of the solvent.
- # Instead of leasing, purchase your own parts washer. Service agreements tend to change your solvents more often, which generates more waste. Also, if you are a conditionally exempt small quantity generator, you can transport your spent solvent and sludge to an approved facility.
- # Talk to other facilities to find out which system works best. This will save you time and money trying to decide which system is best for you.
- # When a supplier or vendor lets you demo a parts washer, make sure you specify that he takes away the whole unit, including the spent solvent if you decide not to buy the unit. Disposing of the spent solvent will cost you money.
- # Buy a parts washer with a drain shelf that fits inside the basin. This allows solvent to drain from parts prior to removing them from the washer.
- # Buy a parts washer with a filtering unit that will extend the life of the solvent by

filtering out contaminants. Remember, when discarding the filters, a hazardous waste determination must be made prior to disposal.

- # Parts washers that are heated seem to work better than unheated units.

The types of metal cleaning that can be used in the electronics/computer industry include: solvents (both halogenated and nonhalogenated), electrocleaning, and aqueous (alkaline and acid) cleaners. Electrocleaning uses an electrical current to clean the workpiece. The following is a brief description for some types of cleaning systems.

Solvent Cleaners

Considered as one of the best types of parts cleaning, chlorinated solvent vapor degreasers have strict air emissions standards due to VOC emissions (See Section II, page 15, under Air Regulations). The main advantage of using chlorinated solvents such as trichloroethylene, perchloroethylene, or methylene chloride is their cleaning effectiveness, especially in vapor degreasers. As a result of using these hazardous solvents, handling and disposal is more involved and expensive than other cleaning alternatives. Because of these strict requirements, electronics facilities are investigating alternative cleaning methods. If your facility uses solvent vapor degreasers, here are some methods to improve the efficiency of these units:

- # Install refrigeration coils in addition to water coils. Coils can help reduce vapor generations by approximately 40%;
- # Cover the degreasing unit at all possible times. The best type of cover is a motor-controlled cover which can be closed automatically;
- # Keep the tip of the spray wand below the vapor level during spraying operations;

- # Remove parts from the degreaser slowly. Also, raise and lower the basket of soiled parts gently;
- # Rack the parts so that the solvent drains out of the holes, joints, and crevices.

Aqueous Cleaners

Aqueous cleaning refers to the use of water, detergents, acids, and alkaline compounds rather than organic solvents. These cleaners are also made up of builders, surfactants, inhibitors, and chelators.

Builders are a basic ingredient of aqueous cleaners. The most common builders are sodium hydroxide, potassium hydroxide, and sodium silicates. These are all alkalines and are difficult to rinse.

Surfactants, also known as wetting agents, are used to reduce the surface tension of the cleaning solution. **Emulsifiers** take oils into the solution and keep them from re-contaminating the workpiece. Unfortunately, most surfactants are also emulsifiers. Aqueous cleaners work by breaking down the organic soils with builders and solubilizing them with emulsifiers. This tends to leave a large amount of spent wastewater. Weak emulsifiers, however, tend to keep the oils in suspension as long as the solution is agitated, but the emulsion breaks when the agitation stops. The soils can be removed and the solution can be reused.

Inhibitors are used to reduce the effect of highly alkaline or acidic cleaners on sensitive substrates. Inhibitors are also used to prevent rusting or oxidation of parts after cleaning. Chromates and silicates are commonly used pH inhibitors, but chromates have environmental disadvantages. Also, inhibitors can make rinsing more difficult and adversely

affect subsequent plating operations.

Chelating agents are designed to keep the metal ions in solution. This, however, can cause problems with wastewater treatment.

Aqueous cleaners are one of the most popular choices for degreasing parts and are a good alternative to the petroleum-based and halogenated solvents. The most common types of aqueous processes are: immersion with ultrasonic agitation, immersion with mechanical agitation, or spray washing. Aqueous cleaners can generally be used instead of solvent cleaners at removing soils and particulate matter. However, when soils and greases are part of the contamination, other steps might be needed to provide adequate cleaning. The rinsing and drying are of great concern since water can remain on the parts and cause rust. Therefore, aqueous systems require more elaborate rinsing and drying procedures.

In many cases, wastewater from aqueous cleaners or semi-aqueous processes may need to be treated before discharging to a POTW. Contaminants include organic matter (oil and grease), metals, and alkaline cleaners which may raise the pH to unacceptable levels. Pretreatment technologies include gravity separators, ultrafiltration, chemical treatment, precipitation, and carbon adsorption. If your facility is treating wastewater from aqueous or semi-aqueous processes, see “Can You Treat Or Recycle Your Wastewater?”, page 26.

Some benefits of aqueous cleaners include:

- # Less risk of hazardous exposure for workers and more environmentally friendly.
- # Not flammable or explosive.
- # Oils and greases can be removed more

effectively.

Potential savings in disposal costs.

The sludge from oil, grease, dirt and other contaminants should be cleaned out frequently. Prior to disposal, you must make a hazardous waste determination on the sludge. Nonhazardous sludge can be hauled by a septic tank company or dried sludge can be taken to a landfill. If you are a conditionally exempt small quantity generator (CESQG), dried sludge that is considered hazardous can be taken to an approved DEC facility as long as you get prior approval from the facility operator. You may want to check with your local landfill operator for requirements.

Semi-Aqueous Cleaners

These cleaners are also called: less toxic solvents, less hazardous solvents, non-halogenated solvents, petroleum-based solvents or terpene solvents.

Semi-aqueous cleaners are products that can be dissolved in water or applied in a concentrated form. They are called semi-aqueous because they can be applied either way. Terpenes are hydrocarbons derived from wood or citrus fruits, usually orange or lemon peel oils. Even though most of the semi-aqueous cleaners are not ozone depleters, they are highly toxic to aquatic life, some have a high cost and they may still be considered a hazardous waste when spent. A hazardous waste determination should be made prior to disposal.

Ultrasonic Cleaners

This method uses high frequency sound waves to improve the cleaning efficiency of aqueous or semi-aqueous cleaners. The sound waves create microscopic sound bubbles that implode when the sound wave moves and the zone changes from negative to positive pressure.

This process exerts enormous pressure (approximately 10,000 psi) and temperatures that loosen the contaminants and actually scrub the workpiece. Ultrasonic cleaning allows non-chlorinated degreasing to be practiced in applications where solvents had been the only effective degreasing tool. Ultrasonic can be used on ceramics, glass, aluminum, and plastic as well as electronic parts, wire, cables, rods, and detailed items that might be difficult to clean by other processes.

Electrocleaning

Electrocleaners are basically heavy-duty alkaline cleaners and are always used with an electric current either reverse, direct, or periodic reverse. These systems are designed for soil removal and metal activation where the work is immersed in the solution and current is applied. The objective of electrocleaning is to remove all the soils and activate the metals surface. The gas scrubbing of the oxygen assists in the removal of soils while the reverse current aids in soil removal and prevents the deposition of any metallic film or non-adherent metal particles. A dilute mineral acid dip usually follows the final cleaner to neutralize the alkaline film on the metal surface.

Acid Cleaning (Pickling)

This process is used to remove contaminants (e.g., oxides, scale, or tarnish) from the workpiece using an acid. It is also used to neutralize any base remaining on the parts. In the pickling process, the workpiece passes from the pickling bath through a series of rinses and then on to the plating operation. Acid pickling is similar to acid cleaning, but is more commonly used to remove the scale from semi-finished mill products, whereas acid cleaning is used for near-final preparation of metal surfaces prior to finishing.

SOLVENT DISTILLATION

If hazardous solvents must be used at your facility, then you may want to consider purchasing a solvent distillation unit to recycle your solvents. For example, if your facility generates five gallons of solvent waste, you may be able to reclaim four and a half gallons of solvent. This would leave you with only one half gallon of sludge that must be disposed of as hazardous waste. This sludge that is generated is called “still bottoms.” Solvent is reclaimed by heating spent solvent to its boiling point and then cooled, which produces nearly pure liquid solvent that can be reused. Spent solvent need only be counted the first time that it is generated in a calendar month if it is reclaimed and reused on site. If spent solvents are counted, then still bottoms don’t need to be counted for the purpose of determining generator category, but do need to be managed as a hazardous waste.

If, however, the solvent is recycled without prior storage or accumulation, then you don’t have to count that quantity, but you must count the sludge for generator category.

Note: If you are required to submit an annual report to DEC, all solvent recycled and all still bottoms must be reported.

POLLUTION PREVENTION TIPS

Here are some pollution prevention tips on managing your degreasing operations:

- # Wipe off parts with a rag or wire brush before soaking in parts washer.

- # Do not clean parts unnecessarily.
- # If possible, try to maintain two parts washers so that you can use one for pre-rinsing.
- # If your parts washer doesn’t have a drip shelf inside the tub, use a drip tray to drain cleaned parts.
- # Turn off solvent stream and cover the unit when not in use. Also, if your unit is equipped with a heating element, turn it off at the end of the day.
- # Store solvent waste in closed containers.
- # Flush parts in freeboard area.
- # Reduce the pooling of solvent on and in parts.
- # Do not fill cleaning machine above fill line.
- # Clean up spills immediately.
- # Store wipe rags in closed metal containers.
- # Do not agitate solvent to the point of causing splashing.
- # When cover is open, control room drafts.
- # Do not clean absorbent materials.
- # Use aqueous or semi-aqueous cleaning systems.
- # Use an aqueous system which uses saponifiers to remove resin based fluxes.
- # Use an aqueous system which utilizes water soluble fluxes instead of CFC 113 during de-fluxing.

Note: CFCs are prohibited for use in solvent cleaning machines.

Plating Baths and Sludges

REGULATORY REQUIREMENTS

Spent plating baths are listed hazardous wastes if they fall into the following categories:

- # F006 - wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum..
- # F007 - spent cyanide plating solutions from electroplating operations.
- # F008 - plating bath residues from the bottom on plating baths from electroplating operations where cyanides are used in the process.
- # F009 - spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.

If your spent plating baths do not fall into one of the above categories, then you must make a hazardous waste determination to see



Figure 10 *The major constituents of copper cyanide baths are potassium cyanide, potassium hydroxide, and copper cyanide. There are many benefits of replacing cyanide-based copper plating baths with a non-cyanide solution.*

if these spent baths exhibit one or more hazardous waste characteristic mentioned in section II of this manual. Wastes generated at electronics/computer manufacturers that aren't listed in 6 NYCRR Part 371 that could exhibit a hazardous characteristic are:

- # plating bath sludges that are not generated from cyanide baths could be hazardous due to toxic metals;
- # alkaline cleaning baths could be corrosive because of a high pH;
- # rinse waters could have a high or low pH depending on the contents of the preceding bath;
- # spent plating baths or cleaning (pickling solutions) containing acids could have a low pH.

POLLUTION PREVENTION TIPS

Extending the useful life of a process bath is an effective means of source reduction of waste. Spent baths must be treated either off-site or on-site by the waste treatment system. Depending upon the type of operation and plating baths your facility uses, here are some tips that could apply to your business:

- # The accumulation of solids reduces the efficiency of the process bath, and removal of these contaminants can extend the life of the bath. Various types of equipment are used to remove suspended solids from plating solutions, with the most common being cartridge filters and diatomaceous earth filters. Cartridge filters are available in either in-tank or external configurations. Most cartridges are disposable, but washable and reusable filters are now available.
- # Carbon treatment of plating baths can be used to remove organic contaminants, either on a continuous or batch basis. The

- carbon adsorbs organic impurities and is periodically changed and disposed of. The most common applications reported in one study were nickel electroplating, followed by copper electroplating (mostly copper cyanide and copper sulphate), zinc plating, and cadmium cyanide plating, respectively.
- # The effectiveness of a bath decreases with use. If your facility can try to dispose of only a portion of the bath and replenish the remainder with fresh chemicals and water, you can help to extend bath life. There are various automated bath monitoring and replenishing systems currently available for this purpose. Alternatively, baths can be adjusted manually by the operator after monitoring key bath characteristics, such as pH or metal concentration.
 - # Natural contaminants found in tap water, such as calcium, iron, magnesium, manganese, chlorine, carbonates, and phosphates have a deleterious effect on plating operations. These substances reduce rinse water efficiency and decrease the potential for drag-out recovery. In process baths, these contaminants decrease bath life and thereby increase the frequency of process bath dumping. In addition, these contaminants increase the volume of sludge produced in a conventional wastewater treatment system. It is therefore advantageous to utilize purified water for process bath makeup and rinsing. Purification may be accomplished by deionization, distillation, or reverse osmosis. In addition, purified water may permit reuse options that are not possible with tap water. This in turn, may reduce the size of the water purification system required as compared to current water use.
 - # Some metal contaminants that enter the plating bath with the workpiece can sometimes be selectively plated out by a process called "dummying." A trickle current is run through the system, and the selected removal of the contaminant metal extends the bath life. The contaminant metals that are most commonly plated out are copper, zinc, iron, and lead. Treatment can be batch or continuous. Batch treatment is usually performed in the process tank during down time.
 - # Carbonates are formed in cyanide baths by the breakdown of cyanide, excessive anode current densities, and the adsorption of carbon dioxide from the air. Excessive carbonates increase the resistance in the bath, resulting in low plating current densities and adversely affecting the smoothness of deposits, plating efficiency, and plating range. Carbonates can be removed from sodium cyanide baths by lowering the bath temperature to approximately -30 EC, where the low solubility of the carbonate salt results in crystallization, permitting subsequent removal from the bath.
 - # Some metal contaminants that enter the plating bath as impurities in anodes can be removed from certain plating baths by chemical precipitation. The precipitate can then be removed by bath filtration. Precipitation is an alternative method to carbonate freezing for cyanide baths and is especially applicable to potassium cyanide baths. Chemicals used for this purpose include barium cyanide, barium hydroxide, calcium hydroxide, calcium sulphate, or calcium cyanide.
 - # Continuous or frequent monitoring of bath parameters can permit the determination of the need for chemical addition or contaminant removal. More frequent bath

- # maintenance can prolong bath life.
- # The prevention of bath contamination by foreign material can significantly prolong bath life. Prompt removal of dropped parts, good rack cleaning, and incoming air filtration are examples of good housekeeping practices.
- # The liquid from the preceding bath that adheres to the workpiece and gets dragged-in to the subsequent tank reduces bath life and effectiveness. Rinsing helps prevent cross-contamination of process baths by removing drag-out into the rinse bath, so that the drag-in to the next process bath is only rinse water.
- # Impurities in anodes will contaminate a process bath. The anodes can be immersed in cloth bags to prevent insoluble impurities from entering the bath, but the bags must be compatible with the process solution and must be regularly maintained. Alternatively, more expensive but more pure anodes may be used, which would decrease this source of bath contamination.
- # Ventilation and exhaust systems can generate waste and increase bath losses. If segregated, some wastes from scrubbers can be filtered and returned to the process bath. Process baths that generate mist should be in tanks with more freeboard in order to reduce the amount of mist that reaches the ventilation system.
- # **Chelators** are used in process baths in order to control the concentration of free metal ions in the solution. Unfortunately, chelating compounds inhibit the precipitation of metals so that additional chemicals must be used in wastewater treatment, which consequently increases sludge volume. Also, some spent process

baths can contain chelators which may not be effectively treatable on-site, resulting in increased hazardous waste disposal costs. Non-chelated process chemistries can be used for some cleaning processes in which it may not be necessary to keep metals that have been removed from the workpiece surface in solution. These metals can be allowed to precipitate but must then be removed by filtration. Continuous filtration of the non-chelated process bath results in increased operating costs, but savings will be realized in reduced waste treatment and



Figure 11 *This type of plating operation is not recommended. Overflowing tanks cause unnecessary wastewater to be treated before it is discharged from the facility.*

- handling costs.
- # Waste streams containing free cyanide are typically treated using sodium hypochlorite or chlorine to accomplish oxidization, and complex cyanides are commonly precipitated using ferrous sulphate. These chemicals contribute to sludge volume, so that using non-cyanide process chemistries may both eliminate a treatment step and reduce sludge volume. Many non-cyanide processes are difficult to treat, however,

and produce more sludge than cyanide baths. Therefore, users will have to determine the specific advantages and disadvantages of switching processes at their facility.

- # Reducing the volume of drag-out from process baths serves to reduce the amount of valuable process chemicals that contaminate the rinse water, which in turn reduces the amount of sludge that is generated by a conventional metal precipitation treatment system.
- # Drag-out can be reduced by keeping the chemical concentration of the process bath at the lowest acceptable operating level, since the greater the concentration of chemicals in solution, the greater the viscosity. Consequently, the film that adheres to the workpiece as it is removed from the process bath is thicker and requires more time to drain back into the process tank. In addition, the chemical concentration of the drag-out film is greater.
- # The viscosity of the process solution can be reduced by increasing the bath temperature, which in turn reduces drag-out since the film drains from the workpiece more quickly. However, a limit on the operating temperature is usually imposed by the brighteners which break down. Operating process baths at higher temperatures increases the evaporation rate from the tank, and water from the following rinse tank can be used to replenish the process bath.
- # Wetting agents (surfactants) can be added to a process bath in order to reduce the surface tension of the solution and thereby reduce the drag-out loss. However, wetting agents can create foaming problems in process baths, and bath chemistries should be evaluated for

their compatibility with wetting agents. Also, the effect of these agents on the wastewater treatment or rinse water recovery system needs to be assessed.

- # Drag-out loss can be reduced by strategic positioning of the workpiece on the rack. Workpieces should be oriented so that the adhering film drains freely and does not get trapped in grooves or cavities. Parts should be tilted so that drainage is consolidated, since fluid flowing together in a preferred route will drain more quickly. Parts should not be positioned directly over one another in order to avoid drainage onto the part below. Also, the workpiece should be oriented so that only a small surface area contacts the solution surface as the workpiece is removed from the process bath.
- # The faster a workpiece is removed from the process bath, the thicker the film on the workpiece surface and thus the greater the drag-out volume. The effect is so significant that it is believed that most of the time allowed for drainage of a rack should instead be used for withdrawal only.
- # As the workpiece rack is raised above the process tank, air can be blown at the workpieces to improve the drainage of the drag-out solution into the process bath. High humidity air can be used in order to counteract workpiece drying.
- # Spray or fog rinse systems can be used above heated baths to recover drag-out on the workpiece. Purified water should be used for these systems in order to reduce bath contamination from the rinse water. The spray rinse flow rate should be adjusted to be equal to the evaporation rate of the tank so that the spray rinse is used to replenish the process bath.
- # Contaminated plating baths can increase

drag-out by as much as 50 percent because of the increase in solution viscosity, (e.g., a cyanide plating bath contaminated with carbonate). You can remove organic contaminants with activated carbon filters. Quick removal of fallen workpieces helps to prevent contaminant accumulation. Avoid drag-in of contaminants.

Drain boards capture process solution that drips from the workpiece rack as it is moved from the process bath to the rinse system, and return the solution to the process bath. Drain boards should cover the space between the process tank and the rinse tank which also serves to prevent drippage onto the floor. Removable drain boards have the advantage of still permitting access to the space between the tanks.

Drag-out tanks, also called dead or static rinse tanks, are essentially rinse tanks that operate without a continuous flow of water and the workpiece is placed in the drag-out tank before the standard rinsing operation. Thus, drag-out from the process bath is captured in the drag-out tank, where the chemical concentration increases over time. Eventually, the chemical concentration in the drag-out tank will increase to the point where it can be used to replenish the process tank. For this reason, drag-out tanks are primarily used in conjunction with process baths that operate at an elevated temperature where evaporation is significant. Purified water should be used in the drag-out tank so that contaminants do not build up in the process bath where the drag-out solution is used for replenishment.

Recovering the drag-out from process baths offers the potential for significant

savings due to the reduction of bath replenishment costs and the reduction of wastewater treatment requirements.

Evaporators can be used for recovery of chemicals in rinse water. The evaporator usually operates off the plating bath, in order to enhance the rate of evaporation of water from the bath to make room for the addition of the rinse overflow from the first rinse tank. The most common uses are for chromium and nickel plating baths. Atmospheric evaporators are the most common, which operate at atmospheric pressure and elevated temperatures. Vacuum evaporators are a more expensive alternative, but they are more energy efficient and they recover the water vapor for use as make-up water. In addition, vacuum evaporators can be used for solutions that are heat sensitive, or for alkaline cyanide solutions where the buildup of carbonates is problematic due to the aeration used in atmospheric evaporators.

Ion exchange is a chemical reaction wherein an ion from solution is exchanged for a similarly charged ion attached to a resin bed. Ion exchange can be used for chemical recovery of rinse water, or in select cases for plating bath maintenance. With rinse water recovery, both an anion and cation exchange resins are used in order to deionize the water. The rinse water can be re-circulated in a closed loop. When the capacity of the unit is reached, the resin is regenerated and the ions are concentrated into a manageable volume of solution. Ion exchange has been used for rinse water recovery with nickel plating, chromium plating, non-cyanide zinc plating, cadmium cyanide plating, and gold cyanide plating. The major use of ion exchange in plating bath maintenance is for

the removal of iron and trivalent chromium from hexavalent chromium plating solutions. These cations reduce the performance of the bath, but can be removed by ion exchange while the chromate anions remain in solution.

Electrowinning is an electrolytic process whereby the dissolved metals in the solution are reduced and deposited on the cathode. The deposited metal is subsequently recovered either by scraping or chemical means, for reuse as anode material or for off-site refining/reuse. Electrowinning can thus be used to recover metal from a drag-out tank, allowing return of the electrowinned solution to the rinse tank. However, because electrowinning does not remove all dissolved solids, the drag-out solution must periodically be purged in order to control the accumulation of dissolved solids. Electrowinning is used in a wide variety of plating applications, including gold, silver, copper, cadmium, and zinc plating operations.

Electrodialysis utilizes ion-permeable membranes and applied current in order to separate ionic species from an aqueous solution. It is primarily used for recovery of nickel from rinse tanks, where it allows the return of concentrated nickel solution to the plating bath. The potential advantage of electrodialysis is that the selectivity of the membrane can be chosen so as to permit the recovery of desirable plating bath organic constituents (such as saccharin), while inhibiting the recovery of some undesirable organic materials that would otherwise accumulate. Thus, electrodialysis can be more effective than other recovery methods such as evaporation and reverse osmosis.

Reverse osmosis is a separation process

that utilizes a semi-permeable membrane to produce purified water and a concentrated ionic solution from a feedstock of dilute solution. High pressure is used to force the water through the membrane, while most dissolved salts are retained by the membrane. The concentrated components can be recovered and then returned to the process bath, and the treated water can be reused as a high quality source of rinse water. The most common application of reverse osmosis in the plating industry is in the recovery of drag-out from nickel plating solutions. The advantages of this technology over competing processes, such as evaporation, are that it is a low temperature, low energy process, which generates a recovered water stream of acceptable quality for reuse as rinse water. The drawbacks are that the membranes can be fouled by suspended solids and/or precipitation products, necessitating cleaning or replacement, and that the membranes have a limited lifetime. Furthermore, reverse osmosis concentrates (and thus returns to the process) both essential plating chemicals and unwanted impurities, unless some post-treatment is performed, but this aspect is common to other recovery options as well.

Printed Wiring Boards

REGULATORY REQUIREMENTS

Shredded PWBs are eligible for an exclusion from the definition of solid waste under 6 NYCRR 371.1(e)(1)(xiv) if the following conditions are met:

- # They are stored in containers sufficient to prevent a release to the environment prior to recovery; and
- # They are free of mercury switches, mercury relays, nickel-cadmium batteries, and lithium batteries.

Facilities claiming this exclusion must notify DEC under 6 NYCRR paragraph 371.1(c)(7). The process of shredding PWBs may be exempt from Part 373 permitting under the conditions of the recycling exemption contained in 6 NYCRR 373-1.1(d)(1)(viii).

Rinse Water

The purpose of rinsing is to prepare the surface of the workpiece for the next step in the plating process. A film of process solution that is picked up in the previous plating step clings to the workpiece. Rinsing must remove enough of this film to ensure that the solution in the next process tank will be effective and remain uncontaminated. In order to do this effectively, the plater should provide turbulent motion between the workpiece and the water, provide adequate period of contact between the workpiece and the water, and provide sufficient water during contact in order to reduce the concentration of the salts that are washed off the surface.

Rinse water is usually discharged with the wastewater treatment plant effluent. Probably most of the hazardous waste produced in an electronics/computer manufacturing facility comes from wastewater generated during rinsing operations that follow cleaning and plating operations. By increasing rinse efficiency, a facility can significantly reduce wastewater which will result in savings from

the cost of water and wastewater treatment. Treatment chemical use and sludge generation should be reduced, with the amount dependent on rinse water hardness and the sludge precipitation chemicals used. Also, clarification and filtration efficiency should be increased, as should the overall treatment plant spare capacity.

REGULATORY REQUIREMENTS

As in the case of spent plating baths, rinse waters could contain listed hazardous wastes as a result of drag-out from previous tanks. When discarding your rinse water and they fall into the following categories, then they are considered listed hazardous wastes:

- # F006 - wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.
- # F007 - spent cyanide plating solutions from electroplating operations.
- # F008 - Plating bath residues from the bottom on plating baths from electroplating operations where cyanides are used in the process.
- # F009 - spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.

If your rinse waters do not fall into one of the above categories, then you must make a hazardous waste determination to see if these rinse waters exhibit one or more hazardous waste characteristic mentioned in section II of

this manual. Some wastes generated at electronics/computer manufacturers that aren't listed in 6 NYCRR Part 371 that could exhibit a hazardous characteristic are:

- # rinse waters that are not generated from cyanide baths could be hazardous due to toxic metals;
- # rinse waters could be corrosive because of a high pH;
- # rinse waters could have a high or low pH depending on the contents of the preceding bath.

POLLUTION PREVENTION TIPS

Rinse water can be enhanced by generating turbulence and increasing the contact time between the workpiece and the rinse water. Here are some tips that your facility can try:

- # Spray rinses and rinse water agitation can be used to create turbulence at the workpiece surface. A spray rinse alone may not provide sufficient cleaning for some workpieces, and therefore may be used in conjunction with an immersion rinse under spray or fog rinses. Alternatively, workpieces can be agitated in the rinse water by moving the workpiece rack or creating turbulence in the water. Hand rack lines permit rack movement by the operator, with movement into and out of the rinse tank being most effective. The rinse water itself can be agitated with forced air or water. Air bubbles create the best turbulence for removing the process solution from the workpiece surface, but misting caused by the air bubbles breaking at the liquid surface may result in air pollution.
- # The feasibility of increasing the contact

time between the workpiece and the rinse water will be different for each facility. Rotation plating increases contact time by allowing operators to leave workpiece racks in the rinse water while they handle other racks.

- # Multiple rinse tanks can be set up in series in order to significantly reduce the amount of rinse water used, and also increase the contact time. In countercurrent rinsing, the workpiece flow moves in the opposite direction to the rinse water flow. The rinse water overflow from the last tank is used as the feed to the preceding tank, and so on for the number of tanks in the series, with only the overflow from the first tank going out of the system. The obvious limitation on the applicability of this method of rinse water reduction is the availability of floor space for the added tanks.
- # Rinse water control devices can increase the efficiency of a rinse water system by eliminating excessive water use. Oversized piping permits the rinse water flow rate to be increased beyond that necessary for effective rinsing, which wastes water and therefore should be deterred. In addition, controls can be put in place to ensure that rinse water is not left running when the rinse tanks are not being used.
- # Flow restrictors limit the volume of rinse water flowing through a rinse system by maintaining a constant flow of fresh water through a rinse system once the optimal flow rate has been determined. These restrictors can also be used upstream to ensure that operators must turn off unused rinse systems in order to operate another rinse system.
- # Conductivity-actuated flow control devices control the fresh water flow through a rinse system by means of a conductivity

sensor that measures the level of ions in the rinse water. When the ion level reaches a preset minimum, the sensor activates a valve that shuts off the flow of fresh water to the rinse system. When the concentration builds up to the preset maximum level, the sensor again activates a valve to resume the flow of fresh water;

- # Recycling and recovery technologies either directly use waste from one process as raw material for another process or recover valuable materials from a waste stream before they are disposed. Segregating waste streams is essential for most recycling and recovery technologies since other wastes, if mixed in, can disrupt the reuse or recycling process. The chemical properties of a waste stream must be understood in order to assess the potential for reuse/recycling or recovery.
- # After rinse baths become too contaminated for their original purpose, they may be useful for other rinse processes. For example, the effluent from a rinse following an acid cleaning bath may be reusable as an influent to a rinse system following an alkaline cleaning bath (known as reactive rinsing). Reusing rinse water in this way can improve rinse efficiency by accelerating the diffusion process and reducing the viscosity of the alkaline drag-out film. Care must be exercised to ensure that tank materials and pipes are compatible with the rinse solutions. You should evaluate the various rinse water requirements for your process lines and determine how you can take advantage of rinse water reuse opportunities that do not affect product quality.
- # Typically, spent acid or alkaline solutions are dumped when contaminants exceed an acceptable level. These solutions, if they

remain sufficiently acidic or alkaline, may be useful as pH adjusters in the treatment operations. However, it is important to ensure that the process solutions are compatible before they are used in this manner. Alternatively, chemical suppliers may have reclamation services, some of which permit certain spent plating baths to be returned.

See section on plating baths for additional pollution prevention tips.

Shop Towels

REGULATORY REQUIREMENTS

Industrial rags (also known as shop towels) or soiled clothing, that are contaminated with listed or characteristic hazardous wastes do not have to be managed as hazardous wastes when sent to a commercial, non-commercial laundry, or dry cleaner to be cleaned and then returned to the owner. The following conditions must be met:

- # There is no exemption for rags or soiled clothing contaminated beyond saturation (containing free liquids). Any rags or soiled clothing containing free liquids will be subject to full regulation.
- # Rags and soiled clothing must be managed in accordance with 6 NYCRR Part 372 and Subpart 373-1 until the materials are sent for laundering and counted as wastes generated and accumulated for the purpose of determining generator category. However, you are required to submit an annual report to DEC, you must report all hazardous rags in this report.
- # All rags and soiled clothing that contain

flammable materials must be stored and transported in fire proof containers.

POLLUTION PREVENTION TIPS

Here are some tips on managing your shop towels:

- # Send your shop towels to a laundry or dry cleaning service. You only have to manage your shop towels in accordance with the hazardous waste regulations until they leave your shop.
- # If your facility is large enough, you may consider purchasing a centrifuge to collect and recycle excess solvent from your shop towels. Most laundries will not accept saturated shop towels. *Centrifuges may be costly, which would **not** make this a cost-effective purchase for small businesses.*
- # Store your shop towels in metal safety cans to reduce the risk of fires. If your shop towels contain solvents, they should be stored in a double-bottom drum to allow the solvent to drip where it can be collected.
- # To reduce the risk of spontaneous combustion when storing shop towels, keep the towels moist with water.

Sludges

See section on plating baths.

Used Oil

REGULATORY REQUIREMENTS

Used oil is not regulated as a hazardous

waste if it is recycled or burned for energy recovery. This means that your used oil, if not mixed or contaminated with hazardous waste, can be managed under the used oil regulations, 6 NYCRR Subparts 360-14 and 374-2. Used oil includes used crankcase oil, metal working oils, gear oil, transmission fluid, brake fluid, hydraulic fluid, dielectric fluid (excluding PCBs), and tank bottoms from used oil tanks only.

If you are disposing of any used oil rather than recycling or burning for energy recovery (i.e., spills, soil contamination, cleanup), or your used oil is mixed with other wastes, then you must make a hazardous waste determination and comply with any applicable hazardous waste regulations.

Remember
All retention tanks for storing used oil must be registered with DEC.

Used Oil Storage Tanks

All used oil retention tanks, no matter what size, must be registered with DEC and clearly labeled "USED OIL." However, fees are required only if the storage capacity of the used oil tank is greater than 1,100 gallons, and the used oil is burned on site for heating. For more information on registration of petroleum storage tanks, please call (888) 457-4351.

Secondary Containment

Secondary containment is any structure which is designed to prevent leaks and spills from reaching the land or water outside the containment area. All aboveground tanks with

a capacity of 10,000 gallons or more must be equipped with secondary containment. All aboveground tanks smaller than 10,000 gallons are required to be equipped with secondary containment if it is reasonably expected that the facility is within close proximity to ground or surface waters of the state. Facilities within 500 feet of the following resources may be considered presumptive evidence of being in close proximity to ground or surface waters:

- # perennial or intermittent stream;
- # public or private well;
- # primary or principal aquifer;
- # wetlands as defined in 6 NYCRR 664;
- # lake, pond, estuary, etc.; or
- # storm drain.

Did You Know?

- # It takes 42 gallons of crude oil to yield 2.5 quarts of lubricating oil.
- # When used oil is recycled, it takes about one gallon to yield 2.5 quarts of lubricating oil.
- # Used oil from a single oil change can contaminate a million gallon water supply for 10,000 people.
- # Used oil is the largest single source of pollution in our nation's waterways.
- # Used oil can contain toxic substances such as arsenic, benzene, cadmium, lead, and zinc.
- # There are 1.2 billion gallons of waste oil generated annually in the United States.

Transporting Used Oil

- # Your facility can transport up to 500 pounds (roughly 55 gallons) of used oil at one time to an approved used oil management facility.
- # Your facility can transport up to 500 pounds (approximately 55 gallons) of used oil to a facility owned by your

company.

- # If you transport over 500 pounds of used oil, you are required to have a DEC 6 NYCRR Part 364 transporter's permit to transport used oil.
- # You cannot transport used oil to a service station or business unless they are authorized by DEC to accept used oil.

Used Oil Space Heaters

Facilities can burn their own used oil and used oil from do-it-yourselfers in specially designed used oil-fired space heaters (furnaces) as long as the following requirements are met:

- # The space heater is rated at less than 500,000 British Thermal Units (BTUs) per hour.
- # The space heater is vented to the outside.
- # The waste oil to be burned contains no chemical waste.
- # Compliance with the provisions of 6 NYCRR Part 225-2.

POLLUTION PREVENTION TIPS

Here are some tips on managing your used oil:

- # Store used oil in closed containers labeled "USED OIL." This is also a requirement under the used oil regulations.
- # Do not mix hazardous waste with used oil. This can contaminate your used oil with hazardous waste, and therefore, no longer be managed as used oil.
- # Make sure your used oil storage tanks or drums have proper containment in case there is a leak or spill.
- # Inspect your used oil storage tanks or

- drums on a regular basis for leaks or spills.
- # Use large drum funnels or fill tubes when filling used oil drums.
 - # Place drip pans underneath leaking machines to collect dripping oil. Don't forget to pour oil from drip pan into the used oil drum.
 - # If you have to service a vehicle on-site, try to prevent spills. If spills do occur, clean up oil spills with rags. After wringing out the saturated rag into the used oil drum, you can have the rags laundered. See section on Shop Towels for requirements.
 - # Avoid using absorbents for oil spills unless there is a threat of the spill spreading to soil or water. Oily absorbents must be evaluated prior to disposal to determine whether they are hazardous or nonhazardous. Remember, if your used oil is not destined for recycling, then a hazardous waste determination must be done on your used oil.
 - # Send used oil for recycling. Although EPA and DEC allow burning in used oil-fired space heaters as a matter of economics for small businesses, EPA recognizes in promulgating this allowance that space heaters do pollute.

Some Commonly Asked Questions

Q I just cleaned up an oil spill with absorbents, can I throw this waste in the dumpster?

A Absorbents generally cannot go in the dumpster, even if they are not a hazardous waste. Solid wastes must be transported by a Part 364 permitted hauler if the transporter is hauling more than 500 pounds total of industrial/commercial solid waste. Most oil spills can be avoided. Have you employees use care when handling containers that can have the potential to spill. Other spilled chemicals may require a hazardous waste determination as well. If you are in doubt, check with your supervisor.

Q Several employees are concerned with odors from the soldering operations at the facility. Are there any regulations that require vents to be installed to at this facility?

A If your soldering operation is hand-held or manually operated, then DEC does not require a registration or permit for this soldering process. If, however, the soldering operation is not a hand-held or manual operation, then this production process would be regulated under 6 NYCRR Part 212. Depending upon your emissions, DEC will determine if a registration or permit is required by your facility.

Q How do I know when my spent

electroplating baths and sludges are hazardous waste when I discard them?

A Some spent baths and sludges are listed hazardous wastes if they fall into the categories listed in 6 NYCRR Part 371. These categories are also described on page 50 of this manual under plating baths and sludges. If, however, your spent bath or sludge is not a listed hazardous waste, you must make a determination on the waste.

Q I just purchased a facility and I plan on doing an assembly operation. I still have some wastewater to discharge but there are no public sewers. There is a floor drain in the middle of my shop but I am not sure where it empties. The only water that empties into this drain is from my operations floor area. Are there any special regulations that I have to comply with?

A If your discharge from this floor drain does not end up in a public sewer or some type of holding tank, then there is a good chance you are in violation of the Environmental Conservation Law (ECL) for an illegal discharge to surface or groundwaters. You should determine where the floor drains discharge by using some environmentally safe dye or food coloring. Any wastewater from an industrial operation into the ground or surface waters of the State is illegal.

Q I have a two part question. I have determined that my rinse water from my copper plating operation is hazardous. In order to minimize my hazardous waste generation I have installed an evaporator system that treats this rinse water before I discharge it to my POTW. I am still

confused as to (1) what hazardous wastes I have to count as part of my hazardous waste generation count, and (2) does this differ from the hazardous wastes that I count toward my annual report if I am a large quantity generator?

A First of all, you should be familiar with counting to determine your “generator category” and counting wastes for your “annual report.” To answer part two of the question: if you are a large quantity generator (LQG), all hazardous wastes that your facility generates (except those that have exemptions) must be counted in your annual report. This includes shop towels, solvents, wastes that you recycle on-site, sludges, or any other wastes that are hazardous. Small quantity generators (SQGs) and conditionally exempt small quantity generators (CESQGs), on the other hand, do not need to fill out or submit annual reports to DEC. Part one of the question refers to counting hazardous wastes generated at your facility to determine your generator category, which could be either a CESQG, SQG, or LQG. When determining your generator category, you do not have to count wastes such as, universal wastes, spent lead-acid batteries that are reclaimed, used oil managed under 6 NYCRR part 360-14, solvents that are taken directly from an operating machine and put directly into a still for recycling, or other wastes that are specifically exempted from counting. However, as mentioned previously, if you are a large quantity generator, and even though you do not necessarily have to count these wastes as part of determining your generator category, these wastes must be counted when submitting your annual report to DEC. **Example:** If you have a copper plating operation at your

facility and use an evaporator to treat your rinse water before it is discharged to a POTW, you would need to do the following: Assuming that the Technical Determination Section at DEC has determined that this evaporator is a wastewater treatment unit, your rinse water, even though it is considered a hazardous waste, does not have to be counted when determining your generator category. However, if you are determined to be a LQG, the rinse water from this evaporator must be counted when filing your annual hazardous waste report to DEC. The evaporator bottoms are classified as an F006 hazardous waste and need to be counted for the purpose of determining generator category. If you are a LQG, they must also be counted when filing your annual hazardous waste report.

Section IV - Pollution Prevention

INTRODUCTION

The Resource Conservation and Recovery Act (RCRA) has a great impact on the electronics/computer manufacturing industry because it governs hazardous waste generators. This federal regulation was enacted to protect human health and the environment, as well as reduce the amount of waste generated and ensure that wastes are managed in an environmentally sound manner.

DEC is promoting pollution prevention because it is often the most cost-effective option to reduce pollution, as well as the environmental and health risks associated with pollution. Even businesses that do a good job of managing their materials and wastes can end up spending large amounts of money, time, and other resources on environmental compliance. Pollution prevention provides a means of meeting, and possibly reducing a business's environmental compliance requirements, while also saving money and improving their economic competitiveness. It is a proactive, "common-sense" approach to environmental management. By reducing, or eliminating, the generation of pollution in the first place, a business can save itself valuable resources.

In most cases, pollution prevention does not involve expensive and "high-tech" process changes. Many pollution prevention options for electronic/computer manufacturers are simple and of minimal cost.

The best way to reduce pollution is to prevent it in the first place. Some companies have implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, process changes to reuse by-products,

improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by practicing some simple pollution prevention strategies.

Waste segregation (separation or preparation) involves avoiding the mixture of different types of wastes and avoiding the mixture of hazardous wastes with nonhazardous wastes. This makes the recovery of hazardous wastes easier by minimizing the number of different hazardous constituents in a given waste stream. Also, it prevents the contamination of nonhazardous wastes. An example of this is the segregation of wastewater sludge by metal contaminants.

The following is a list of some general pollution prevention methods that your business can use to minimize waste at your facility. The term pollution prevention (P2) refers to the elimination or reduction in volume or toxicity of waste prior to generation or prior to recycling, treatment or release to the environment. Pollution prevention can also be referred to as waste reduction, waste minimization, or source reduction. An effective pollution prevention program can:

- # Reduce the risk of criminal and civil liability.
- # Reduce your operating costs.
- # Improve employee morale, participation, and safety.
- # Enhance your company's image in the community.
- # Protect the public health and the environment.

GENERAL POLLUTION

PREVENTION TIPS

Implementing a successful housekeeping program, as a rule, requires little or no capital investment. Keep in mind that substantial savings will not be achieved if routine surveillance procedures are not implemented. Here are some housekeeping methods you can try at your facility:

- # Always obtain the material safety data sheets (MSDS) from your supplier or vendor for any chemical you use in your shop. They provide specific information about the material.
- # Inspect all shipments and return all unacceptable or damaged materials; especially those items that could become hazardous wastes once they are signed for.
- # Practice preventive maintenance of equipment.
- # Cover solvent tanks when not in use to reduce evaporation.
- # Improve your purchasing and inventory methods to ensure that materials do not exceed shelf life. Date all raw materials and chemicals and use the first-in, first-out method of inventory control. Expired and outdated materials that can't be used create waste.
- # Turn off electrical equipment such as lights and copiers when not in use.
- # Train employees in all areas, especially in chemical handling and spill response.
- # Segregate hazardous from nonhazardous wastes.
- # Use high efficiency fans, blowers, and filters (about 50% efficient) at your facility. Fans, blowers, and filters used to maintain ultra-clean air are an integral part of a facility's operation. There can be hundreds of fans in use that run 24 hours a day, 7 days a week. Most fan filters in

use are only 10-20% energy efficient. A centrifugal blower/motor can be up to 25-30 percent efficient, and some other units are higher.

- # Repair leaks around processing equipment (e.g., tanks, valves, pump seals, transfer lines, heating coils). Losses of 2 gallons per hour can occur through leaking pump seals alone.
- # Install anti-siphon devices equipped with self-closing valves on inlet water lines where warranted.
- # Inspect tank and tank liners periodically to avoid failures that might severely overload the waste treatment system.
- # Inspect plating racks frequently for loose insulation that would cause excessive drag-out of plating solutions.
- # Ensure that cyanide solutions do not mix with compounds (e.g., iron, nickel) that would form wastes that are difficult to treat.
- # Use dry clean-up where possible instead of flooding with water.
- # Install drip trays and splash guards where required.

For example:

Correcting an average loss of 1 gallon per hour from cyanide and chromium tanks and 2 gallons per hour from caustic soda storage would reduce the operating costs by more than \$20,000 per year.

Remember, the first step in establishing a pollution prevention program at your facility is to implement employee awareness. One way this can be achieved is by offering training sessions on regulatory compliance and waste minimization so that your employees can familiarize themselves with the proper waste

management strategies.

Even though your business may generate a small amount of waste, keep in mind that there are thousands of businesses that generate a small amount just like you. Together these businesses generate a large amount of waste that must be managed properly.

All hazardous waste generators, except conditionally exempt small quantity generators (CESQG), are required to manifest their hazardous waste as required under the Environmental Conservation Law (ECL) 27-0907. These generators must sign a certification on the manifest form that, "the generator of hazardous waste has in place a program to reduce the volume or quantity of toxicity of such waste to the degree determined by the generator to be economically practical." A good source of guidance is the "Hazardous Waste Reduction Plan - Guidance Document," available by calling the Bureau of Hazardous Waste Management of the Division of Solid and Hazardous Materials at (518) 485-8988.

The following pollution prevention options include practices that reduce the use of

hazardous materials, energy, water or other resources, and practices that protect natural resources through conservation or more efficient use. These options can be divided into: **process or equipment modifications, raw material substitution, and recovery of materials.**

Process or Equipment Modifications

Process or equipment modifications can reduce the amount of waste generated at your electronic/computer facility that perform such operations as electroplating, etching, or cleaning operations. Here are some pollution prevention options you may want to try:

- # installing countercurrent rinsing systems which will enhance water conservation.
- # using counter flow and cascade rinsing systems to conserve consumption of water.
- # redesigning rinse tank to conserve water;
- # regenerating plating bath by activated carbon filtration to remove built up organic contaminants.
- # installing drag out recovery tanks to reduce generations of drag-out.
- # installing flow restrictors on flowing rinses.
- # installing a pH controller to reduce the alkaline and acid concentrations in tanks.
- # installing an atmospheric evaporator to reduce metal concentrations.
- # using reactive rinsing and multiple drag-out baths.
- # controlling the water level in rinse tanks to improve sludge separation, and enhance



Figure 12 *Employees at this facility know that labeling and record keeping of hazardous materials is an important step in maintaining a good pollution prevention program.*

- recycling of supernatant to the process by aerating the sludge.
- # installing a system that applies flux to printed wiring boards, which leaves little residue and eliminates the need for cleaning with CFCs.
- # installing ion exchange system to reduce generation of drag-out.
- # installing a reverse osmosis system to reduce generation of drag-out.
- # using electrolytic metal recovery to reduce generation of drag-out.
- # utilizing electrodialysis to reduce generation of drag-out.
- # implementing evaporative recovery to reduce the generation of drag-out.
- # implementing the electrodialysis reversal process for metal salts in wastewater.
- # install a system to reduce pressure to vaporize water at cooler temperatures, recycle water by condensing the vapors in another container, and concentrate and precipitate solutes.
- # reduce chrome waste generation by installing a rain cover on outdoor tanks.
- # reduce chrome waste generation by treating on-site with caustics and sodium bisulfite to reduce hexavalent chromium to trivalent chromium sludge.
- # reduce chrome waste generation by repairing water leaks in process rinse tank.
- # modify sludge pretreatment processes by adding flow control valves.
- # modify sludge pretreatment processes by installing metal recovery equipment.
- # modify sludge pretreatment processes by adding a deionization system.
- # redesign board during board assembly to implement pollution prevention measures.
- # use mechanical cleaning as an alternative to chemical methods.
- # make process efficiency improvements for applying photopolymers, printing, and

developing.

- # use alternative processes for connecting the PWB layers together.
- # use alternatives to lead-based soldering involving the use of lasers, reactive gases, or ultrasonics.
- # reduce building of contamination in bath solutions by increasing process efficiency (e.g., implement ion exchange technology).

Control Drag-Out by:

- # increasing bath temperature.
- # decreasing withdrawal rate of parts from plating bath.
- # increasing drip time over solution tanks and racking parts to avoid cupping solution within part cavities.
- # shaking, vibrating, or passing the parts through an air knife.
- # using wetting agents to decrease surface tension in tank.
- # using drip bars to reduce the drag-out;
- # using drain boards between tanks to reduce generations of drag-out.

Practice Water Conservation by including:

- # fog or spray rinsing;
- # purified, softened water, or deionized water, rather than tap water that will help prevent the build-up of mineral salts and other impurities that affect rinsing quality
- # dead rinses;
- # conductivity controllers that measure total dissolved solids (TDS) concentration in rinses and control electrically-operated flow control valves;
- # agitation to assure adequate rinsing and homogeneity in rinse tank;
- # flow control valves.

Raw Material Substitution

Raw material substitution or elimination is the replacement of existing raw materials with other materials that produce less waste or a non-toxic waste. Examples include substituting non-cyanide solution for a sodium cyanide solution in copper plating baths and replacing hexavalent chromium with trivalent chromium plating systems. Here are some pollution prevention options you may want to try:

- # Substitute cyanide plating solutions with alkaline zinc, acid zinc, acid sulfate copper, pyrophosphate copper, alkaline copper, copper fluoborate, electroless nickel, ammonium silver, halide silver, methanesulfonate-potassium iodide silver, amino or thio complex silver, no free cyanide silver, cadmium chloride, cadmium sulfate, cadmium fluoborate, cadmium perchlorate, gold sulfite, and cobalt harden gold.
- # Substitute sodium bisulfite and sulfuric acid for ferrous sulfate in order to oxidize chromic acid wastes, and substitute gaseous chlorine for liquid chlorine in order to reduce cyanide reduction.
- # Replace hexavalent chromium with trivalent chromium plating systems.
- # Replace cyanide with non-cyanide baths;
- # Replace conventional chelating agents such as tartrates, phosphates, EDTA, and ammonia with sodium sulfides and iron sulfates in removing metal from rinse water which reduces the amount of waste generated from precipitation of metals from aqueous waste streams.
- # Replace methylene chloride, 1,1,1-trichloroethane, and perchloroethylene (solvent-based photochemical coatings) with aqueous base coating of 1% sodium carbonate.
- # Replace methanol with nonflammable alkaline cleaners.

- # Substitute a non-cyanide for a sodium cyanide solution used in copper plating baths.
- # Substitute sodium persulfate etchant (acid etch solution) with hydrogen peroxide/sulfuric acid.
- # Replace chlorinated solvent baths with a non-hazardous product.
- # Recover copper by electrolytic processes.
- # Substitute semi-aqueous or aqueous photoresist for trichloroethane (TCA) and methylene chloride during board manufacturing.
- # Substitute no-clean fluxes for TCA during board assembly.
- # Substitute aqueous or semi-aqueous clean fluxes for TCA during board assembly.
- # Substitute other solvents for CFC 113 and TCA during board assembly.
- # Replace lacquer in panel preparation with a wax-like material similar to floor wax. It provides the necessary coating without a high VOC content.
- # Replace Freon as a cleaning agent for removing particulate contaminants from panel mask frames with air blow cleaning and an aqueous wash.
- # Use less hazardous cleaning chemicals, such as isopropyl alcohol, as alternatives to acetone or chlorinated solvents in maintenance and cleanup processes.
- # Use substitutes for chromium-based photoresists.
- # Use alternatives to the lead-based frit used in sealing the funnel with the panel mask.

Recovery of Wastes

Recovering wastes and reusing them as an ingredient or feedstock in the production

process on-site can help your business save money. Examples include: recovering copper during the etching processes, recovering lead and tin from printed wiring boards, and installing a closed-loop recycling system to reduce/reuse water consumption. Here are some pollution prevention options you may want to try:

- # Send drag-out waste to another company for waste exchange.
- # Reuse rinse water.
- # Reuse drag-out waste back into process tank.
- # Recover process chemicals with fog rinsing parts over plating bath.
- # Evaporate and concentrate rinse baths for recycling.
- # Use ion exchange and electrowinning, reverse osmosis, and thermal bonding when possible.
- # Use sludge tagging techniques to extract and recycle metals.
- # Use hydrometallurgical processes to extract metals from sludge.
- # Remove and recover lead and tin from PWBs by electrolysis or chemical precipitation.
- # Install a closed loop batch treatment system for rinse water to reduce water use and waste volume.
- # Install an electrolytic cell which recovers 92 percent of dissolved copper in drag-out rinses and atmospheric evaporator to recover 95 percent of chromic acid drag-out, and recycle it into chromic acid etch line.
- # Oxidize cyanide and remove metallic copper to reduce metal concentrations.
- # Recover copper by electrolytic processes;
- # Convert sludge to smelter feed.
- # Convert an open-top still into a closed loop system to recycle Freon 113.

- # Use a system to reprocess sulfuric acid generated during wafer fabrication operations. The acid is heated to boil off water and other impurities, purified through distillation, and pumped back into wet stations to continue wafer processing.
- # Segregate wastewater sludge to prepare for metal recovery.
- # Regenerate acids for glass cleaning and frit removal in waste glass recovery operations using existing technologies and equipment.
- # Reclaim and reuse photoresists from one of the panel preparation processes.
- # Recover soluble lead generated during the waste glass recovery operation by ion exchange resins. Reuse this lead your smelting operations.
- # Improve phosphor solution recovery and recycling efficiencies to further reduce discharge of metals to the environment.
- # Reduce or recover wastes, such as: chrome wastes, cleaning materials (hydrofluoric acids) EP effluent, furnace slag, cullet dust, fugitive dust, refractory brick wastes, and alcohols.

Section V - Resource Guide

The following organizations provide technical assistance, publish information, conduct or speak at workshops and conferences, and provide telephone, written and on-site information to generators on pollution prevention and better management of air, water, solid and hazardous waste issues.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

50 Wolf Road, Albany, NY 12233

Division of Solid & Hazardous Materials

Bureau of Hazardous Waste Management

(518) 485-8988

Responsible for making hazardous waste determinations, reviewing hazardous waste reduction plans, hazardous waste permitting.

Pollution Prevention Unit

Small Quantity Generator Hotline

(800) 462-6553

This technical assistance unit offers workshops/training, publications, information clearinghouse, pollution prevention conferences, and toxic release inventory.

Division of Air Resources

Bureau of Stationary Sources

(518) 457-7688

This bureau is responsible for source review, permitting, MACT, NESHAP implementation, and air toxics assessments.

Division of Water

Bureau of Water Permits

(518) 457-1157

Responsible for managing the State Pollutant Discharge Elimination System (SPDES) permits, the SPDES program for storm water discharges, the water resources programs, and the municipal water supply permits.

Petroleum Bulk Storage Hotline

(888) 457-4351

Provides technical assistance on chemical and petroleum above/underground storage tanks.

Division of Environmental Permits

Waste Transporter Section

(518) 457-2224

This office is responsible for issuing permits to waste haulers that transport solid and hazardous, industrial/commercial, sewage and septage waste.

Division of Solid & Hazardous Materials

Bureau of Waste Reduction & Recycling

(518) 457-7337

This bureau is responsible for the waste tire program, the beneficial use program, the composting program, and other solid waste recycling and waste reduction issues.

Spill Response Hotline

(800) 457-7362

To report releases of petroleum products or hazardous substances to air, land or water. Regulations require reporting within 2 hours if certain conditions are not met. Also, the National Response Center should be notified.

Division of Environmental Remediation

Bureau of Spill Prevention and Response

(518) 457-9412

Responsible for the registration of tanks, conducting workshops and training, developing publications, spill notifications.

NYSDEC Regional Offices

REGION 1

Nassau & Suffolk Counties
Building 40 SUNY at Stony Brook
Stony Brook, NY 11794
(516) 444-0375

REGION 2

Bronx, Kings, New York, Queens and
Richmond Counties
1 Hunters Point Plaza
Long Island City, NY 11101
(718) 482-4900

REGION 3

Dutchess, Orange, Putnam, Rockland, Sullivan,
Ulster & Westchester Counties
21 South Putt Corners Road
New Paltz, NY 12561-1696
(914) 256-3000

REGION 4

Albany, Columbia, Delaware, Greene,
Montgomery, Otsego, Rensselaer, Schenectady
& Schoharie Counties
1150 North Westcott Road
Schenectady, NY 12306-2014
(518) 357-2234

REGION 5

Clinton, Essex, Franklin, Fulton, Hamilton,
Saratoga, Warren & Washington Counties
Route 86
Ray Brook, NY 12977
(518) 897-1200

REGION 6

Herkimer, Jefferson, Lewis, Oneida & St.
Lawrence Counties
317 Washington Street
Watertown, NY 13601
(315) 785-2513

REGION 7

Broome, Cayuga, Chenango, Cortland,
Madison, Onondaga, Oswego, Tioga &
Tompkins Counties
615 Erie Boulevard West
Syracuse, NY 13204-2400
(315) 426-7400

REGION 8

Chemung, Genesee, Livingston, Monroe,
Ontario, Orleans, Schuyler, Seneca, Steuben,
Wayne & Yates Counties
6274 East Avon-Lima Road
Avon, NY 14414
(716) 226-2466

REGION 9

Allegany, Cattaraugus, Chautauqua, Erie,
Niagara & Wyoming Counties
270 Michigan Avenue
Buffalo, NY 14203-2999
(716) 851-7000

State and Local Assistance

Erie County Office of Pollution Prevention

Department of Environment and Planning
95 Franklin Street, Room 1077
Buffalo, NY 14202-3973
(716) 858-7674

Provides confidential assistance to businesses and the private sector in Erie County.

NYC Department of Environmental Protection, Environmental Economic

Development Assistance Unit
59-17 Junction Boulevard
Corona, NY 11368
(718) 595-4436

Provides assistance to small businesses in New York City.

The Center for Business and Industry

SUNY at Fredonia, Lagrasso Hall
Fredonia, NY 14063
(716) 673-3177

Provides assistance for businesses located in Chautauqua, Cattaraugus, and Allegany counties.

SUNY Buffalo

Center for Integrated Waste Management
Jarvis Hall, Room 207
Buffalo, NY 14260-4400
(716) 645-3446

Provides R&D support to industries, businesses, and governmental agencies.

Broome County Division of Solid Waste Management

Edwin Crawford County Office Building
44 Hawley Street
Binghamton, NY 13901
(607) 778-2250

Provides assistance to residents and businesses in Broome County.

NYS Environmental Facilities Corporation

Small Business Assistance Program
50 Wolf Road, Room 502
Albany, NY 12205
(800) 780-7227
(518) 457-9135

Provides confidential technical assistance to small businesses in New York State on issues regarding the Clean Air Act.

Clean Air Act Small Business Ombudsman

Empire State Development
Small Business Division
633 3rd Avenue, 32nd Floor
New York, NY 10017
(800) STATENY or (800) 782-8369

Provides confidential assistance to small businesses in New York State on issues regarding the Clean Air Act.

Your county or town Department of Health, Public Works Office, or Environmental Management Council may also be able to provide you with information on local regulations and issues.

Federal Assistance

Asbestos and Small Business Ombudsman

401 M Street SW

Washington, DC 20460

Phone: (800) 368-5888

Helps citizens, small businesses, and communities with questions on all program aspects with EPA.

RCRA/Superfund/EPCRA Hotline

401 M Street SW

Washington, D.C. 20460

(800) 424-9346

Answer questions on matters related to solid waste, hazardous waste, or underground storage tanks. Also, can be used to order EPA publications.

EPA Region II Office

Compliance Assistance & Program Support

290 Broadway, 21st Floor

New York, NY 10007-1866

(212) 637-3268

Provides compliance and pollution prevention assistance to EPA Region II area businesses.

EPA Region II Office

Division of Enforcement and Compliance Assistance - RCRA Compliance Branch

290 Broadway, 22nd Floor

New York, NY 10007-1866

Phone: (212) 637-4145

In addition to conducting RCRA inspections on small businesses, this office provides technical assistance on RCRA related issues.

EPA Headquarters

Office of Compliance (2224A)

401 M St., SW

Washington, DC 20460

Phone: (202) 260-1821

Fax: (202) 564-0009

Regulatory, technical, compliance and pollution prevention assistance.

U.S. Department of Transportation

Hazardous Materials Information Center

Office of Hazardous Materials Standards

Research & Special Programs Administration

400 7th Street, SW

Washington, DC 20590-0001

Phone: (800) 467-4922

Technical assistance on matters related to DOT's hazardous materials transportation regulations.

Pollution Protection Information Clearinghouse (PPIC)

PPIC-EPA

401 M Street, SW (7409)

Washington, DC 20460

Phone: (202) 260-1023

Fax: (202) 260-0178

E-mail: ppic@epamail.epa.gov

Provides a library and an electronic bulletin board dedicated to information on pollution prevention.

National Response Center

(800) 424-8802

In Washington, D.C. (202) 426-2675

To report oil and chemical spills to the Federal Government. This hotline is manned by the U.S. Coast Guard.

Trade Organizations

American Electronics Association

New York Regional Office
455 Connack Road
Deerpark, New York 11729
Phone:(516) 274-3227
Fax: (516) 274-3231
<http://www.aeanet.org/>

Electronics Industry Alliance (EIA)

2509 Wilson Boulevard
Arlington, Virginia 22201-3834
Phone: (703) 907-7500
<http://www.eia.org>

Association Connecting Electronics Industries (IPC)

2215 Sanders Road
Northbrook, IL 60062-6135
Phone:(847) 509-9700
Fax:(847) 509-9798
<http://www.ipc.org/>

Microelectronics and Computer Technology Corporation

Environmental Programs
3500 West Balcones Drive
Austin, Texas 78759-5398
Phone:(512)338-3672
<http://www.mcc.com>

Semiconductor Industry Association

181 Metro Drive, Suite 450
San Jose, CA 95110
Phone:(408) 436-6600
Fax:(408) 436-6646
<http://www.semichips.org/>

Semiconductor Equipment and Materials International (SEMI)

North America Headquarters
805 East Middlefield Road
Mountain View, CA 94043-4080
Phone:(650) 964-5111
Fax: (650) 967-5375
<http://www.semi.org>

New York State Permitted Household Hazardous Waste Facilities

If you are a Conditionally Exempt Small Quantity Generator and located in one of the following counties, you can call the number listed to make arrangements to bring your hazardous waste for disposal. Appointments are usually required. Some counties are opening their facilities to neighboring counties. If your shop is not located in any of these counties, you may want to call the closest household hazardous waste collection facility for more details.

Broome County

Division of Solid Waste Management
P.O. Box 1766
Government Plaza
Binghamton, NY 13902
(607) 778-2482

Oneida-Herkimer Solid Waste Management Authority

311 Turner Street
Suite 401
Utica, NY 13501
(315) 733-1224

Monroe County

444 East Henrietta Road
Rochester, NY 14620
(716) 760-7610 x7053

Rockland County

50 Sanatorium Road
P.O. Box 350
Pomona, NY 10970
(914) 364-2086

Ulster County Resource Recovery Agency

1266 Ulster Avenue
Kingston, NY 12401
(914) 336-0600

Resources on the Internet

Organization	Internet Address
American Electronics Association	http://www.aeanet.org
Electronics Industry Alliance	http://www.eia.org/grd/eic/eic_docs.htm
Association Connecting Electronics Industry	http://www.ipc.org
Microelectronics and Computer Technology Corporation	http://www.mcc.com/mcc/RnD/env_prog.html
SEMATECH	http://www.sematech.org
Semiconductor Industry Association	http://www.semichips.org
Printed Wiring Board Resource Center	http://www.pwbrc.org
NYS Department of Environmental Conservation - Pollution Prevention Unit	http://www.dec.state.ny.us/website/ppu
NYS Empire State Development Business Assistance Services	http://www.empire.state.ny.us
NYS Environmental Facilities Corporation	http://www.nysefc.org
NYS Energy Research and Development Authority	http://www.nyserda.org
USEPA - Common Sense Initiative	http://www.epa.gov/commonsense
USEPA - Design for the Environment	http://earth2.epa.gov/dfore
USEPA - Enviro\$en\$e	http://es.epa.gov
USEPA - Industry Sector Notebooks	http://es.epa.gov/oeca/sector
USEPA - Small Business Assistance Program	http://www.epa.gov/smallbusiness
USEPA - Office of Underground Storage Tanks	http://www.epa.gov/unix0008/water/muni/under.html
USEPA - Technology Transfer Network	http://www.epa.gov/tnn

U.S. Department of Energy Pollution Prevention Information Clearinghouse	http://epic.er.doe.gov/epic
Pacific Northwest Pollution Prevention Resource Center	http://pprc.org
National Pollution Prevention Roundtable	http://es.epa.gov/nppr
Tellus Institute	http://www.tellus.org
Waste Reduction Resource Center	http://www.p2pays.org

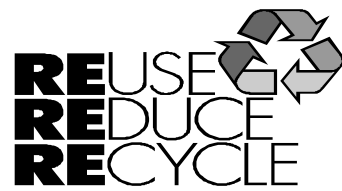
References

Here are some other publications for the electronics and computer industry that you may find useful.

1. Environmental Protection Agency, *Profile of the Electronics and Computer Industry*, September 1995, EPA 310-R-95-002.
2. Environmental Protection Agency, *Guide To Pollution Prevention*, The Printed Circuit Board Manufacturing Industry, June 1990, EPA 625/7-90/007.
3. Environmental Protection Agency, *Guide to Cleaner Technologies, Alternatives to Chlorinated Solvents for Cleaning and Degreasing*, February 1994, EPA/625/R-93/016.
4. New York State Department of Environmental Conservation, *Environmental Compliance and Pollution Prevention Guide for Small Quantity Generators*, March 1998.
5. New York State Department of Environmental Conservation, *Environmental Self-Assessment for the Electronics Industry*, September 1999.
6. New York State Department of Environmental Conservation, *Spill Response: Basic Procedures and Requirements For Responsible Parties in New York State*, January 1991.
7. New York State Department of Environmental Conservation/Empire State Development, *The Environmental Self-Audit For Small Businesses*, January 1998.

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If you have any questions or comments regarding any portion of this publication please contact the NYS Department of Environmental Conservation
Pollution Prevention Unit, 50 Wolf Road, Room 298, Albany, NY 12233-8010
Phone: (800) 462-6553 in New York State
Phone: (518) 457-2553 outside New York State, Fax: (518) 457-2570



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